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MARCH 1934

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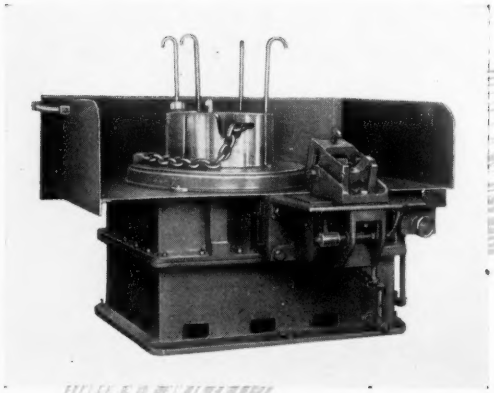

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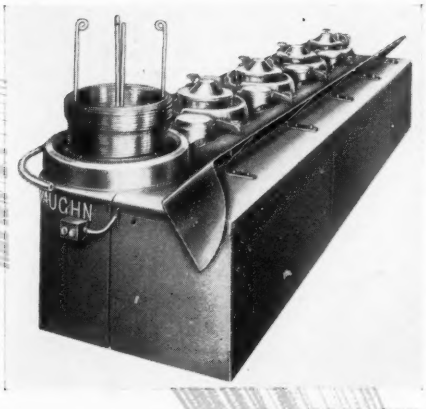

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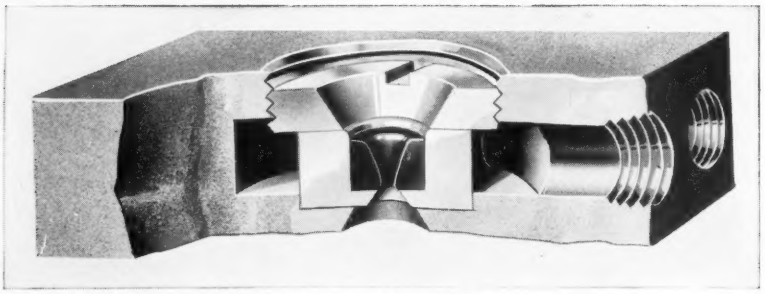
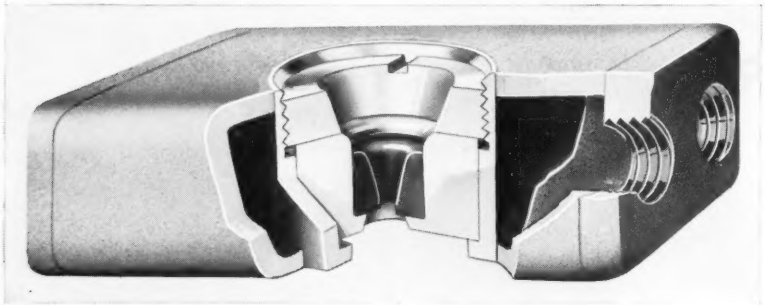
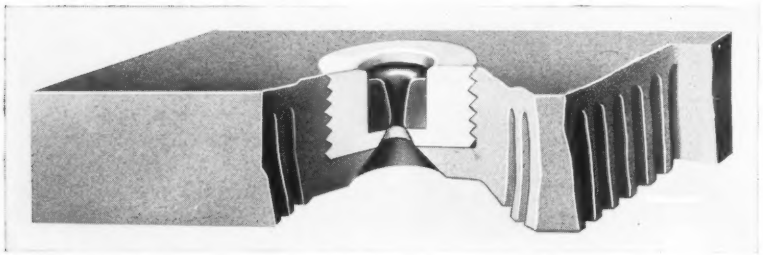


AIR-COOLED • Providing for constant flow of low-pressure air around die casing. Clamping device provides rigidity.



WATER-COOLED • Permits continuous flow of water around die. Clamping device provides rigidity.



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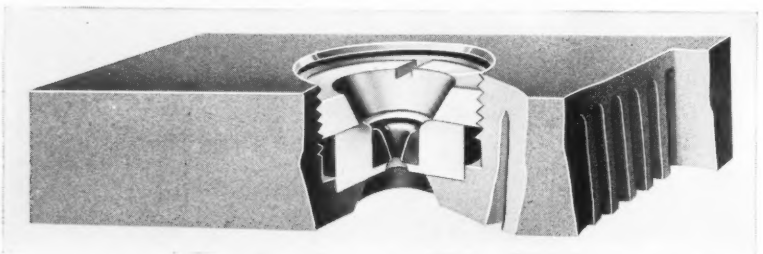

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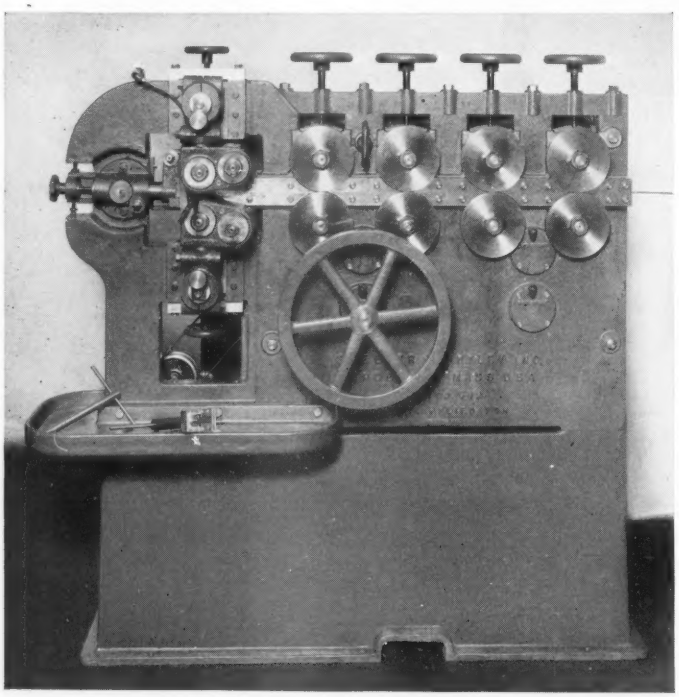

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A monthly publication devoted to the production of Wire, Rod and Strip Wire Products and Insulated Wire and Cable.

DRAWING—ROLLING—EXTRUDING—FORMING—FABRICATING

Vol. 9 March 1934 No. 3

Designated as

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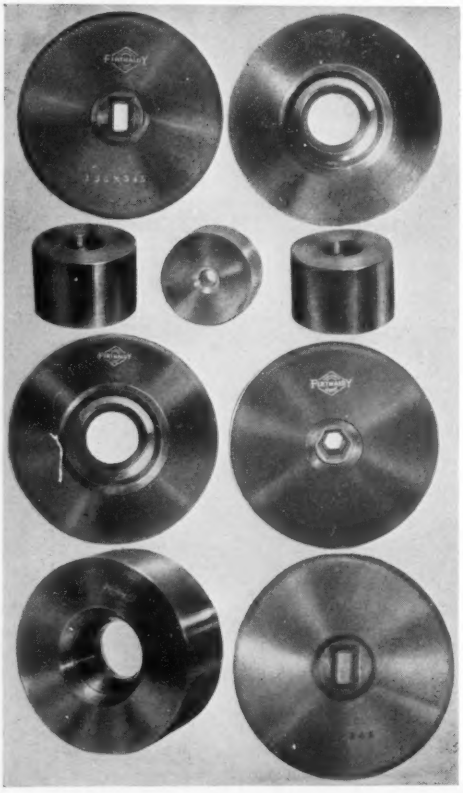

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip.
Wire Products and Insulated Wire and Cable.
DRAWING --- ROLLING --- EXTRUDING --- FORMING --- FABRICATING

Vol. 9 March 1934 No. 3

Hollow Core Bare Transmission Cable

By Moss A. Kent
Assistant General Works Manager, General Cable Corp.
White Plains, N. Y.

Difficult electrical requirements of Boulder Dam project result in the development of a hollow core bare transmission conductor, transmitting 290,000 volts. An outline of the requirements met and a description of the special machinery design and methods developed to produce Type HH Cable.

THERE has just been completed at Los Angeles, California an attractive, new modern factory building with a floor area of approximately 50,000 square feet. To the casual visitor to this new plant, the equipment in it would appear to be standard rolling, cold drawing and stranding equipment such as is found in all other wire manufacturing plants throughout the country. Actually, however, the equipment is much more interesting than it would at first appear; interesting not only to the casual visitor because of the fact that this equipment is the first of its kind in the United States and for that matter in the Western Hemisphere, but interesting to those familiar with the manufacture of electrical wires and cables because of the unusual shapes and forces dealt with by the unique equipment, and of interest to those interested in the transmission of electrical energy at high voltages over long distances because of the vastness of the project and the unusual characteristics of the product produced.

+ + +

THIS factory and its equipment were designed and built primarily for the purpose of manufacturing the copper transmission cable to be used in transmitting electrical energy from the Boulder Dam on the Colorado River in the states of Arizona and Nevada to Los Angeles, California, a distance of 271 miles.

+ + +

The Transmission Line

THIS transmission line when completed will be the outstanding electrical transmission

Fig. 1—Los Angeles plant of General Cable Corp. designed for the production of Type HH Conductor. + + + + + +

line in America and the World. There will be two parallel circuits of three wires each, making a total of 1626 conductor miles. They will transmit electricity at 290,000 volts. Altogether there will be approximately 14,000,000 pounds of copper conductors. This transmission line has been designed and engineered and will be built by the Los Angeles Department of Water and Power, and it is estimated it will take over a year to erect it.

✦ ✦ ✦

The Conductors

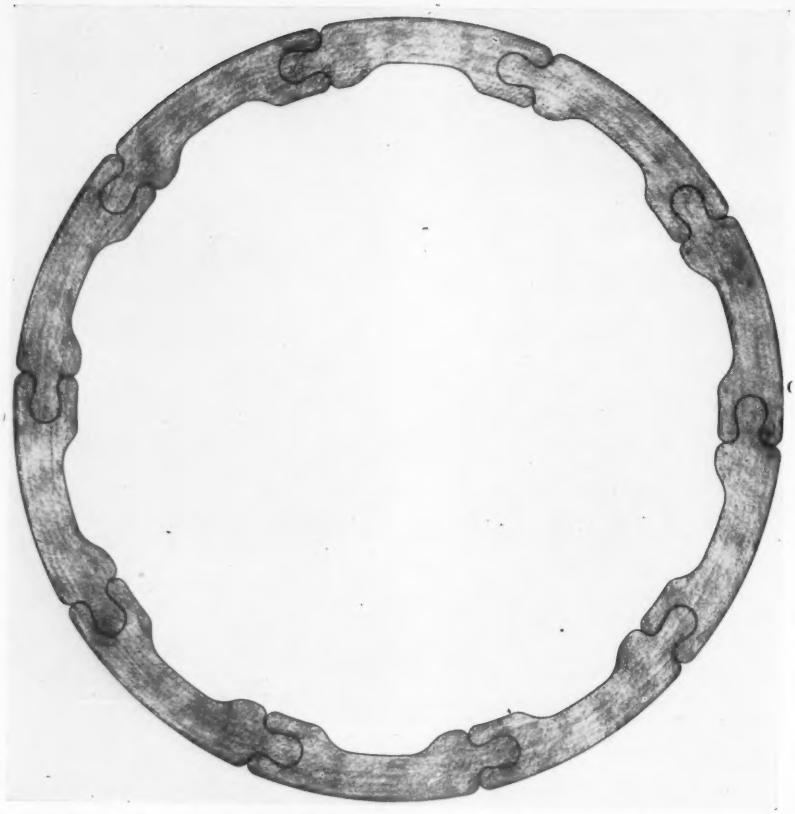

Fig. 2—Cross-section of Type HH Cable showing method of interlocking special shaped segments.

THE conductors themselves are 1.4" in diameter and hollow, appearing to the casual observer much like a copper tubing. Actually, they are copper tubing made of segments tightly interlocked and laid in a spiral, producing a flexible copper cylinder with a relatively thin wall and of tremendous tensile strength and resistance to crushing. This type of conductor is most economical in cost, efficient in operation under any and all operating conditions and incorporates all the benefits of a smooth surface tube for transmission of high voltage currents and yet does not offer the risks of fraying or broken strands which are so frequent in the standard type of bare stranded conductors. This cable is known as type HH and is produced exclusively by General Cable Corporation.

✦ ✦ ✦

FROM an electrical engineering standpoint, the cable is most interesting because of its unusual and unequaled qualities, so much desired in transmission of high voltage electric currents on tower lines. Let us consider briefly the outstanding characteristics of this cable before going on to an outline of the method of manufacture.

✦ ✦ ✦

Power Requirements For The Cable

WHEN a given block of power is to be transmitted from one location to another, a selection must be made of the correct transmission voltage. Technically, it is possible to use a large number of different voltages in any given problem. The correct voltage is determined on the basis of the lowest annual cost. In considering this question, it should be emphasized that voltage determines primarily the cost of the insulation of the line. The current to be used determines the cross-section of conductor.

Fig. 2a—Type HH Cable showing how segments are spiralled.

✦ ✦ ✦

CURRENT and voltage are, however, related to each other in the well-known manner, the product of voltage times current being constant for a giving amount of power. If, therefore, in studying a project to transmit a given amount of power, consideration is given to using a higher voltage, this means necessarily a smaller current. Therefore, the higher voltage means increased cost of insulation but decreased cost of conductor. The most economical voltage is the one which gives the lowest total annual cost after balancing all factors. Higher voltages also mean better regulation and better stability characteristics.

✦ ✦ ✦

AS voltages become higher and higher, the cross-sectional area of the transmission conductor must become smaller and smaller, to obtain the full economy that is theoretically possible.

✦ ✦ ✦

IN overhead transmission lines, the insulation is, of course (1) the air between conductors and (2) the porcelain insulators at the points of support. Increasing the voltage requires increasing the insulation, meaning that more powerful porcelain units are used and greater separation is required between conductors. The resulting decrease in current for a given power would mean conductors

smaller in diameter and lighter in weight.

✦ ✦ ✦

Corona Loses

AS voltages increase on transmission lines, a new phenomenon, namely corona losses, is introduced which changes the above considerations. With sizes of conductor and spacings such as used in transmission lines, if the voltage is raised on a given line, a point will be reached where the air breaks down as an electrical insulator locally near the conductor surface and a glow discharge takes place. This commences at a voltage much lower than that required for complete flashover or arcing between conductors and is a local discharge at the conductor surface only. The discharge can be heard and is visible at night in the form of a purplish glow. The importance of corona is that it results in a loss of electrical energy which may run into many kilowatts per mile. Furthermore, the loss continues night and day on a 24 hour load factor and thus, particularly on long lines such as this, the cost of the corona losses would become prohibitive and consequently must be prevented or kept within very low limits. How can this be accomplished? For a given spacing, elevation and temperature, there is a definite voltage at which corona commences for every diameter of conductor. The larger the diameter of conductor the higher the voltage required to start the corona discharge. For every voltage, therefore, there is a definite diameter of conductor which is required to prevent or minimize to reasonable limits corona losses. If conductors, having a diameter larger than the critical diameter, are used, there will be no corona problem, but smaller conductors cannot be economically used.

✦ ✦ ✦

IT was stated above that voltage determines the insulation and current the cross-section of conductor, i.e. size of conductor or amount of metal. In higher voltage work, however, where corona is a factor, the voltage also limits the diameter of the conductor. In ordinary work, the diameter and the cross-section of a conductor go hand in hand. By size of conductor we usually mean cross-section. If we state the cross-section, we can immediately determine the diameter. A new element is, however, introduced in high voltage transmission conductors. If in studying a given project calculations are made on higher and higher voltages with smaller and smaller currents the cross-section of conductors will decrease with the higher voltages, but the diameter of conductors must increase to prevent corona.

✦ ✦ ✦

Effect On Cable Design

IT is clear, therefore, that transmission lines, to achieve full theoretical economy require conductors whose cross-section and diameter must be independent of each other. What is required is a conductor the diameter of which can be increased without increasing the cross-section or the amount of metal.

✦ ✦ ✦

THE difficulty is to obtain that diameter without having too much metal. In other words, high voltage means small current and therefore small cross-section. The real problem is to obtain the diameter required by the voltage without exceeding the cross-section of conductor needed to carry the current. Any metal beyond this involves an unnecessary increase in the cost of conductor and in the cost of towers. To suspend an unnecessarily heavy conductor is an economic waste.

✦ ✦ ✦

ONE theoretical way of solving this difficult problem would be

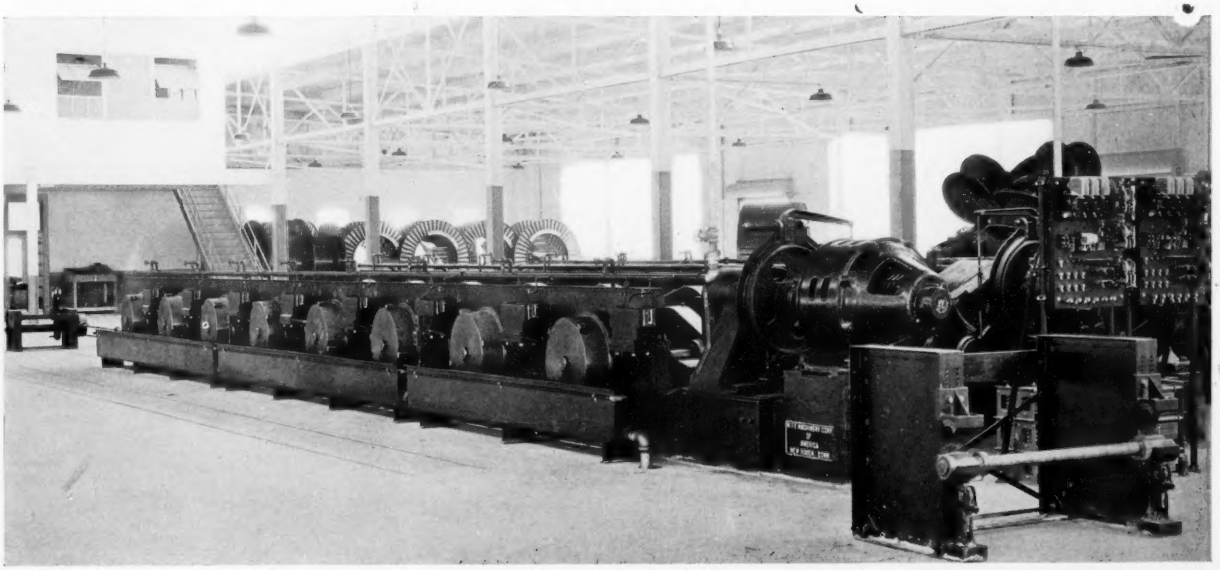

Fig. 3—Special design Multi-Draft Drawing Machines. Note rails for the special stringing up car placed beside the machine. ✦ ✦ ✦

to use a copper tube as a transmission conductor. The diameter required can easily be obtained, and within wide limits the tube could be kept to the small cross-section required merely by using a thin enough wall. Such a tube would have an additional advantage in that the corona losses would be exceptionally low. The solid tube is, of course, impossible on account of its high cost, low flexibility and the fact that large size tubes cannot be made in long enough lengths.

✦ ✦ ✦

Type HH Cable

THIS type HH conductor is in effect an economical, flexible segmental tube which can be made in long lengths required. The conductor itself is a single layer which is self-supporting, no internal supporting members being required. Due to the fact that the individual segments are tightly interlocked, the conductor is very strong, maintains a circular cross-section and is practically uncrushable, even between flat surfaces. Each of the segments is so rugged that they can be made quite thin so that the conductor in effect becomes a thin-walled tube. The tongue of each segment is engaged by the groove of the next segment, so that the tongue cannot come out of the groove. The tongues can, however, move lengthwise in the grooves, thus giving the requisite flexibility to the cable.

✦ ✦ ✦

Advantages of Type HH Cable

THE corona losses of type HH conductors have been measured and are very low, practically of a different order of magnitude from those of cables having round wire on their surface. This is easily understandable because the surface of the type HH conductor approaches a smooth tube which as we know gives minimum corona losses. It is interesting to note in connection with this cable that the alternating current resistance is practically equal to the direct current value; in other words there is no "skin effect" problem.

✦ ✦ ✦

IF the violence of flash of arc is sufficient to destroy one or two outer wires of an ordinary cable, it will do no more than create a burr on the strong type HH segments. Furthermore, the type HH construction has the additional advantage that if a segment is burned through, it will be held in place by the adjacent segments and will not unravel. If one or more wires of a cable with an outer surface of wires is burned through, there is the danger of having the cable unwrap and the loose wires coming in contact with other conductors.

✦ ✦ ✦

ALL conductors in operation vibrate under certain conditions, and fatigue of the metal is always to be reckoned with at the points of support, particularly at the suspension clamps. Vibration tends to occur when the conductor is exposed to a low steady wind. The amount of energy in the vibrating conductor is very small and if this energy can be absorbed by any means, the vibration will be damped out. The theory of most vibration dampers has been to make the vibrating conductor do some frictional work which dampens out the energy of vibration and prevents the motion of the conductor. The individual segments of the type HH cable are so designed that any bending of the conductor is likely to involve relative motion between adjacent segments. This means frictional work and thus the type HH cable itself tends to dampen out vibration which would otherwise occur. This has been checked on actual operating lines where it has been found that it is exceptionally difficult to

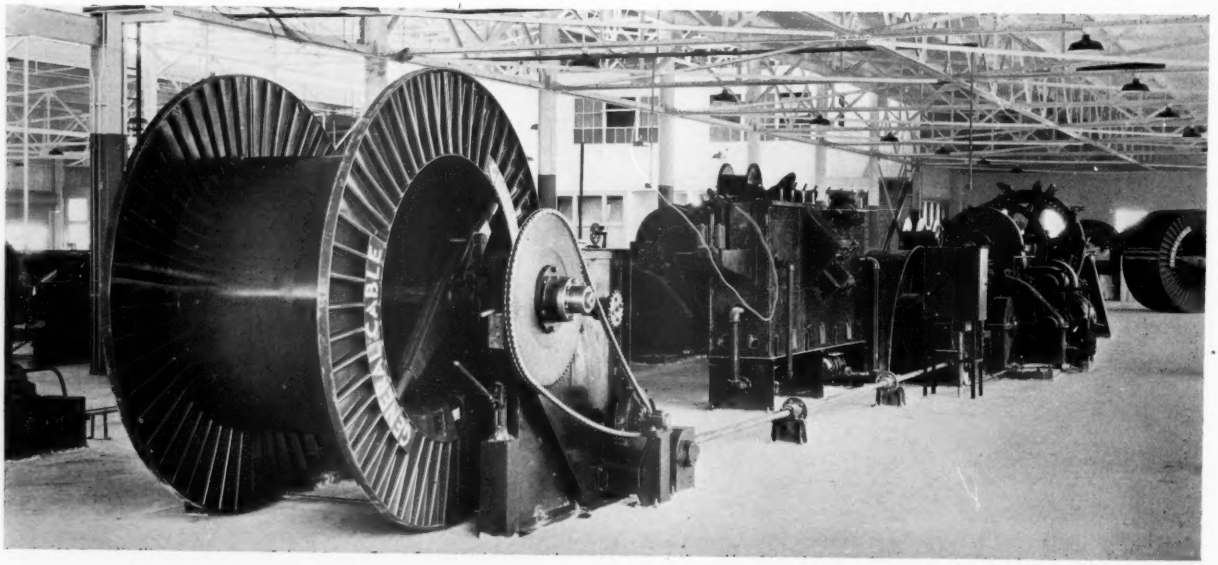

Fig. 4—Operating end of special machine for cabling and interlocking segments showing washing unit in center and reel for finished cable. ✦ ✦

cause any vibration of this type of conductor.

✦ ✦ ✦

THE above outline of the operating characteristics of this particular type of conductor is sufficient to give a general understanding of the conductor characteristics. However, there may be some who are interested in getting more detailed information and comparative data to prove the advantages of this type of cable over other existing types. For such informataion we refer you to articles which have appeared during the past several years in "Electrical Engineering". The last of these articles was published in the 1933 issue, page 845, and was a complete and exhaustive presentation of tests on cables of different types, including type HH, sponsored by the Los Angeles Department of Water and Power at the Harris J. Ryan High Voltage Laboratory at Stamford University. The title of the article is "Corona Losses from Conductors of a 1.4" Diameter", and was written by Joseph S. Carroll, Director, Ryan Laboratory, Stamford University, California and Bradford Cozzen and Theodore M. Blakeslee, Research Engineering Department of Water and Power, City of Los Angeles.

✦ ✦ ✦

Manufacturing Methods and Equipment

AN examination of the type HH conductor immediately raises the question in the mind of anyone who is interested in modern manufacturing methods how it is possible to manufacture in mile lengths the specially shaped sections which make up the conductor. It is apparent that the manufacturing process and the equipment used cannot be the standard garden variety found in all plants manufacturing electric wires and cables. The design and construction of the drawing and cabling equipment for this type HH conductor has required the solution of many new and interesting problems. The equipment while radically new is based upon data secured from a study of methods used abroad in the manufacture of similar cables and from a large amount of experimental work carried on at one of the plants of General Cable Corporation in this country. The machines finally developed for this purpose differ somewhat in construction details but fundamentally are similar to those which have been used heretofore in rolling, drawing and cabling copper wires. It is obvious that the complexity of the finished shape of individual segments and the problems involved in their assembly in a smooth, hollow conductor with sufficient flexibility for practical purposes, and resistance to distortion or collapse, made it necessary in the design of the equipment to deal with forces and problems not encountered in the manufacture of standard cables. Therefore, only in a general way could experience derived from drawing round wire and stranding it into finished cables be used.

✦ ✦ ✦

Rolling the Rod Sections

THE first operation in the manufacture of this is the hot rolling of standard copper wire bars into a special "kidney shaped" rod section of approximately the same area as a 5/16" round rod. This is performed on a standard type of rod rolling mill similar to those used in general practice in the industry.

✦ ✦ ✦

Heating Wire Bars

THE heating of the wire bars prior to rolling takes place in a new design of furnace heated by a gas flame of semi-diffusion type. Most of the heating of the bars is done by radiation from a long yellow flame throughout the greater part of the furnace so that convection becomes a factor namely at the entering end of the furnace. In this way the copper is gently brought to a uniform rolling temperature without overheating any part of the bars.

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Perfect Rods Necessary

THE rolling mill, though of a standard type, has many refinements and handling devices designed to aid in producing the specially shaped rods free from rolled-in scale and surface imperfections. A perfect rod is particularly important because of the difficult drawing operations necessary to produce the very irregularly shaped finished section. Extreme care must be used throughout the heating and rolling operations or the edges of the tongues and grooves will be roughened and torn and cause trouble in the subsequent operations.

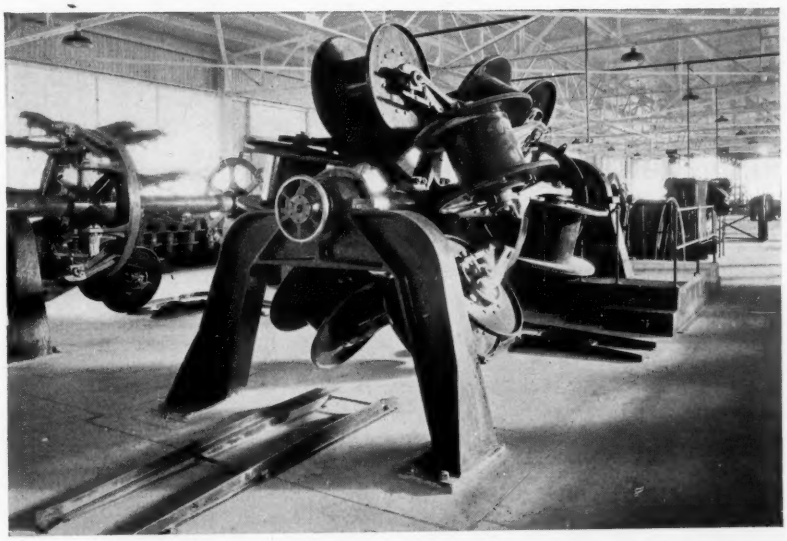

Fig. 5—Cabling machine. Note elimination of hoists by ingenious arrangement of reels and device of rolling the reels on to a truck immediately below and directly into the loading position of the cradle.

The Brazing Operation

AFTER pickling and inspection of the hot rolled rods the next operation is that of brazing the 250 pound coils into long lengths of approximately two and one half tons each on reels. This operation requires much skill as it is necessary to scarf carefully the section to produce a long braze which will perfectly withstand the high stresses required in drawing the finished sections. Coincidentally with the brazing operation, the rod is reduced in section and changed in shape by one draft on a standard bull block to prepare it for the subsequent continuous drawing operation.

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Multi-Draft Drawing Machines

THE principle drawing operation by which the finished segment is produced on reels ready for assembly into the completed cable is performed on a special multi-draft drawing machine. Eight drafts are made in one operation on this machine, making a total of nine reductions, including the bull block pass, in bringing the rolled rod to the proper shape and size. The finished segment has an area of approximately 52,000 circular mils.

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THIS machine is approximately 55 feet long exclusive of payoff and take-up apparatus. It is provided with an automatic electric brake for stopping and with an inching type multi-position push button control with stations at each of the eight capstans. The die holders are massive steel castings into which the dies are held with steel clamps. The drawing lubricant is conveyed to each die by a special circulating system. Throughout the machine is exceedingly rugged in design to enable it adequately and efficiently to handle the forces involved in drawing the hard copper of the peculiarly shaped segments. All bearings in this machine are of anti-friction type and the gears are helical cut gears. The die pull is exceedingly high and the gear is capable of producing a pull of three tons through each of the starting dies. The percentage of reductions differs entirely from those used in ordinary wire drawing practice, and it has been necessary to keep the percentage of slip of the segments on the capstans considerably below that used in regular practice of drawing round wires.

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Stringing-Up Device

DUE to the fact that the sections are so large in area and when hard drawn are so rigid, it is necessary to do the stringing up on the machine. For this purpose a special stringing-up car running on small tracks is provided along the machine and contains a power pointing device of the swedging type, a powerful shear for pointing the swedged section and a special die stringing machine, motor operated. This car moves from capstan to capstan, as each station is strung up successively.

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Cable Reel Take Up

THE device for taking up the finished segments on the cabling reels is equipped with a variable speed unit which holds constant the peripheral speed of the reel as the wire builds up on it. The traverse device is automatic and designed for this segment so that the wire lays up in a smooth layer with no chance of injury to its delicate edges. Approximately 1,700 pounds in one length is put on each cabling reel.

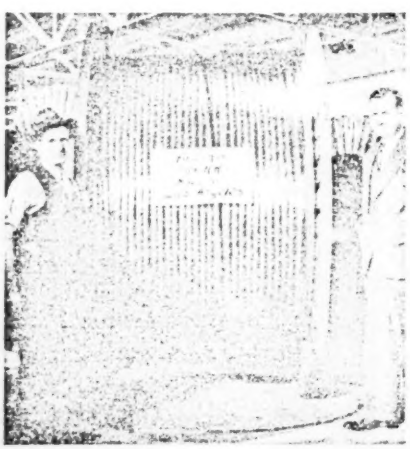

Fig. 6—Cable on steel reels for shipping. ✦

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Machine for Cabling and Interlocking Segments

AT this stage of manufacture of this cable the individual segments have been drawn to exact size in approximately mile lengths and wound upon suitable reels which will be put directly into the cabling machine. The next operation consists of bringing together of ten segments and securely interlocking the tongue of one with the groove of the adjacent one, and at the same time spiraling all segments to give the cable flexibility and resistance to crushing. It is of note that the cable for the Boulder Dam project consists of ten segments giving a total conductor area of approximately 500,000 circular mils. However, the number of segments and the size of each can be produced on the equipment described to meet all requirements and conditions.

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THE cabling and interlocking of these ten segments required the design of a special cabling machine. This machine is so designed that it may produce finished cable with a varying number of segments to a maximum of twelve.

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Unusual Cabling Operation

THE cabling operation differs from ordinary cabling operations in many respects; primarily, the greatest difference is due to the fact that the segments are not only cabled together and interlocked but that their cross-sectional area is further reduced or drawn down as in a seamless tube drawing operation.

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THE control of the grip with which the segments are interlocked and the amount of area reduced in this operation require very close supervision. The helix of the segments is carefully governed and controlled by the gear ratio of the machine, similarly to the lay in standard stranding equipment.

(*Please turn to page 89*)

Dry, Bright Annealing of Copper Wire

By A. R. RYAN

Industrial Engineering Department, General Electric Company, Schenectady, N. Y.

Operating Data on the Dry, Bright Annealing of Copper Wire in Bell-Type Electric Furnaces and the variation of the physical properties of copper under cold working and the effects of annealing temperatures analyzed.

BELL type furnaces equipped with retorts and gas circulating fans have been used during the past two years, on a production basis, for the dry, bright annealing of copper wire. Sufficient operating data from several installations are now available so that the utility of the equipment for the operation in question may be quite accurately determined.

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Factors To Be Considered

WHEN endeavoring to determine the utility of a given equipment for the treatment of a specific material it is necessary to consider the physical characteristics of the material, the process to which the material is to be subjected, factory operating conditions and operating economy. It is therefore fitting that each of these factors be given consideration in this resume of Bell type furnace operating experience.

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Effect of Cold Working On Copper Structure

COPPER in the "as cast" condition has an equiaxed crystalline structure, is extremely ductile and has relatively low tensile strength. However, upon cold working, such as rolling into sheets or drawing into wire while the metal is at a low temperature the crystals are elongated. The internal strains set up by the deformation of the crystals make the metal less ductile and increase the tensile strength. The variations of the physical properties with the degree of cold working are shown graphically in Fig. 1. The cold working may be continued until the internal strain is so great as to fracture the metal, or, if fracture does not occur, until the power required for further deformation becomes excessive.

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What Annealing Does

IN order to prevent fracture of the metal or excessive use of power for further cold working, the internal strains in the metal must be relieved by heating above the so-called "Critical Temperature" which for copper is 390 deg. F. When heated above this temperature, the deformed metallic crystals as shown in Fig. 2 will in time assume their natural equiaxed shape as shown in Fig. 3 and the metal will become ductile and suitable for further cold working. This process of restoring the natural crystal structure is termed annealing.

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Effect of Annealing Temperature

THE rapidity with which the crystals assume their natural

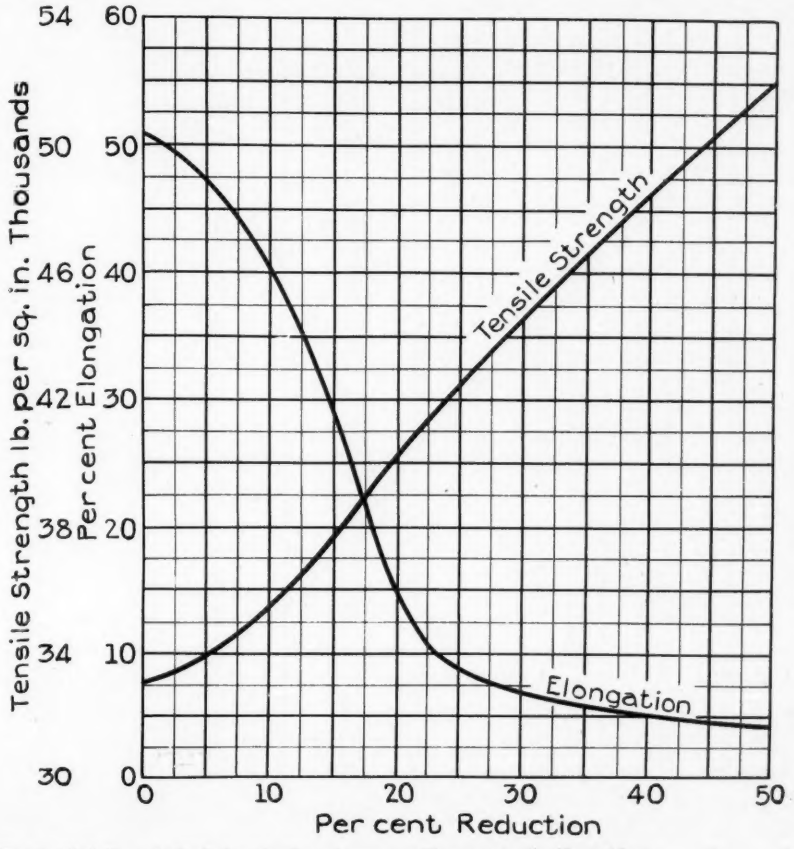

Fig. 1—Variation of physical properties of copper with amount of cold working. ✦ ✦

equiaxed structure, upon heating after deformation, depends primarily upon the annealing temperature and the degree of strain present due to the crystal deformation. It is of economic importance to note that if heated above 390 deg. F. and given sufficient time, the equiaxed structure would ultimately be obtained, while if heated to a temperature of 700 deg. F., the equiaxed structure would be obtained almost instantly. Fig. 4 shows how markedly the metal characteristics change at 700 deg. F. for a short time anneal.

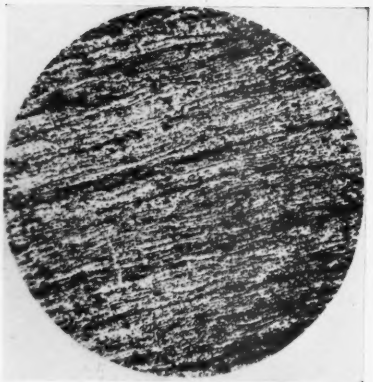

Fig. 2—Microstructure of cold worked copper.

Fig. 3—Microstructure of annealed copper. ✦

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High Temperature Effect In The Presence of Oxygen

IN addition to the foregoing physical characteristics and behavior of copper, there is another characteristic of commercially pure copper that is of importance. Such copper usually contains a small amount of oxygen in the form of copper oxide as an impurity. When the metal is heated to a temperature of about 950 deg. F. and with the metal surrounded by hydrogen, or a mixture of gases containing hydrogen, as is usually the case in a dry, bright annealing process, the hydrogen penetrates the metal and reduces the copper oxide, thereby forming free copper and water vapor immediately becomes high pressure steam, which, on expanding, literally blows the metallic crystals apart, with the result that the metal becomes brittle and is useless unless remelted. Fig. 5 shows the microstructure of a piece of copper after it had been subjected to a high temperature in the presence of hydrogen.

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Annealing Wire Wound On Spools

THE annealing of wire wound on spools requires the consideration of certain practical limitations that may prohibit the use of the optimum annealing temperature. Adjacent turns have a tendency to stick together when fine wire of about .04″ diameter and smaller, is annealed on spools at relatively high temperatures. The tendency may be so pronounced as to cause the wire to break.

Cause of Fine Wire Sticking

A STUDY of the phenomena showed that, in the majority of cases, the sticking was caused by the wire becoming wedged be-

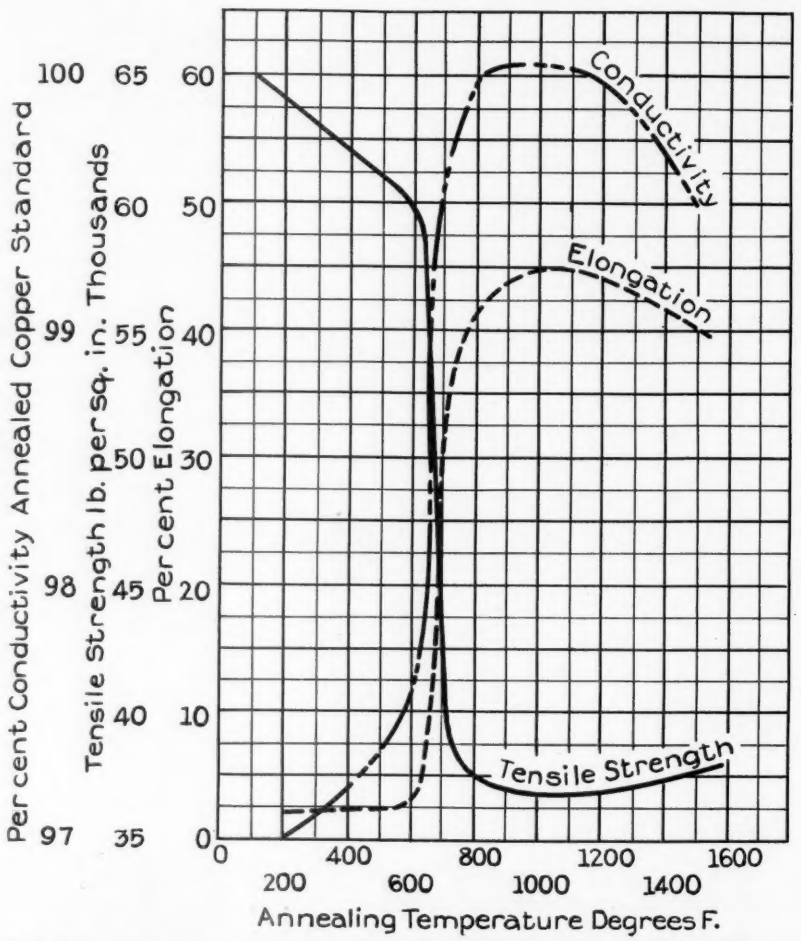

Fig. 4—Variation of physical properties with annealing temperature for a short time anneal. ✦

tween adjacent turns. It was further determined that such wedging action might result from too much strain when reeling after drawing or from the difference in the rates of expansion and contraction of the inner and outer layers upon heating or cooling during annealing.

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Elimination of Sticking

DEPENDING upon the cause, the apparent stickiness can be eliminated by the use of proper reeling tension or by annealing at low temperatures with retarded rates of heating and cooling, especially during the initial parts of either cycle.

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Necessity For Uniformity of Annealing

COPPER is usually received at the wire mill in the form of coils of copper rods in a soft condition resulting from the hot rolling at the mill where they were rolled from ingots. The wire factory starts its operations by cleaning the rods if necessary and then giving them one or more reductions in wire drawing machines until the metal becomes so strained that annealing is necessary before further reduction can be accomplished. After annealing, the wire is further reduced and wound on spools. Some wire is shipped in the strained condition produced by the drawing operations, but the majority of wire produced must be shipped in the soft or annealed condition. Such wire must be uniformly annealed, free from sticking and must have a bright surface condition. These conditions have been obtained during the past two years in the recently developed Bell type furnace.

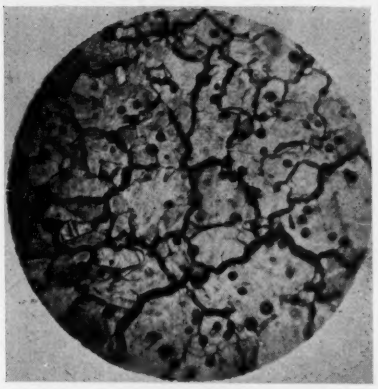

Fig. 5—Microstructure of embrittled copper deoxidized by heating to a high temperature in the presence of hydrogen. ✦ ✦ ✦

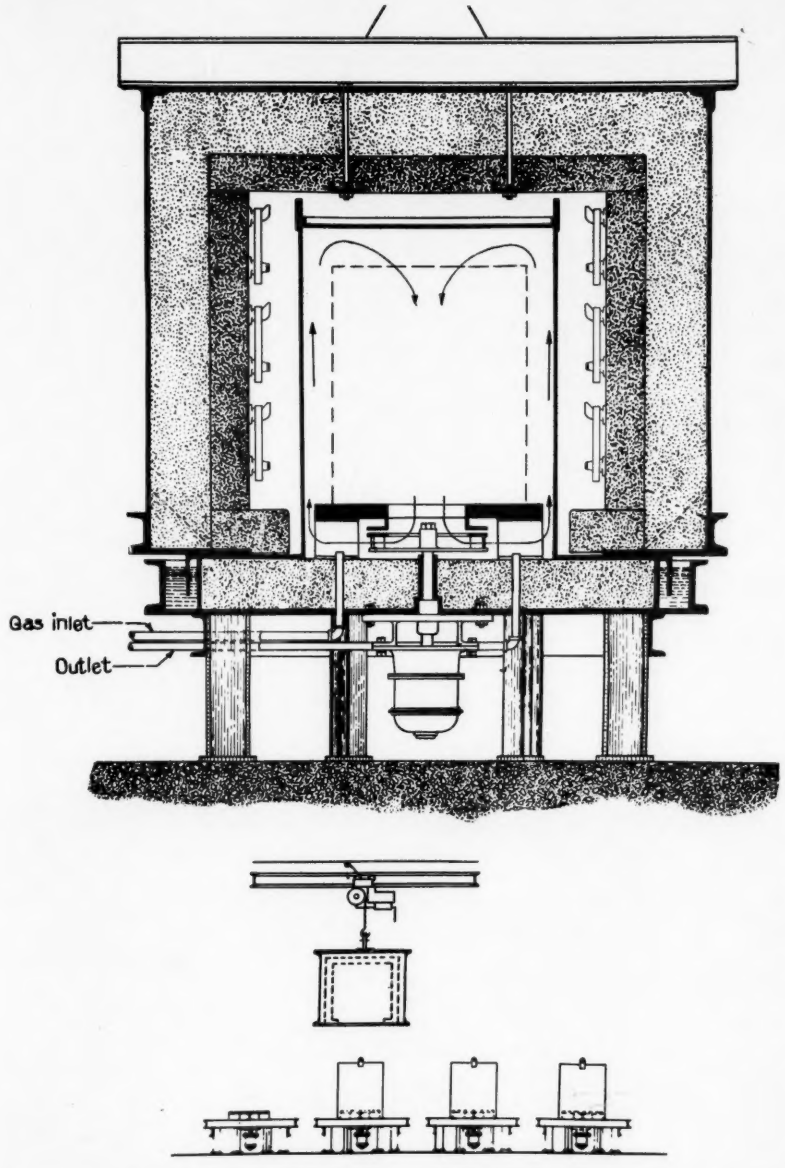

Fig. 6—Bell type, bright annealing furnace witht gas circulating fan in base. ✦ ✦ ✦

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The Bell Type Furnace

A COMPLETE bell type furnace equipment consists of a cylindrical, electrically heated furnace, open at the bottom and so constructed as to be readily portable. The furnace is so designed that it may be placed over a vertical, cylindrical retort, which in turn is placed on top of a furnace base. The furnace base is equipped with a centrifugal type fan by means of which gas may be circulated within the retort. Reference to Fig. 6 will make clear the general construction of this type of furnace, as well as the arrangement of a number of bases and retorts so as to obtain increased output from one furnace.

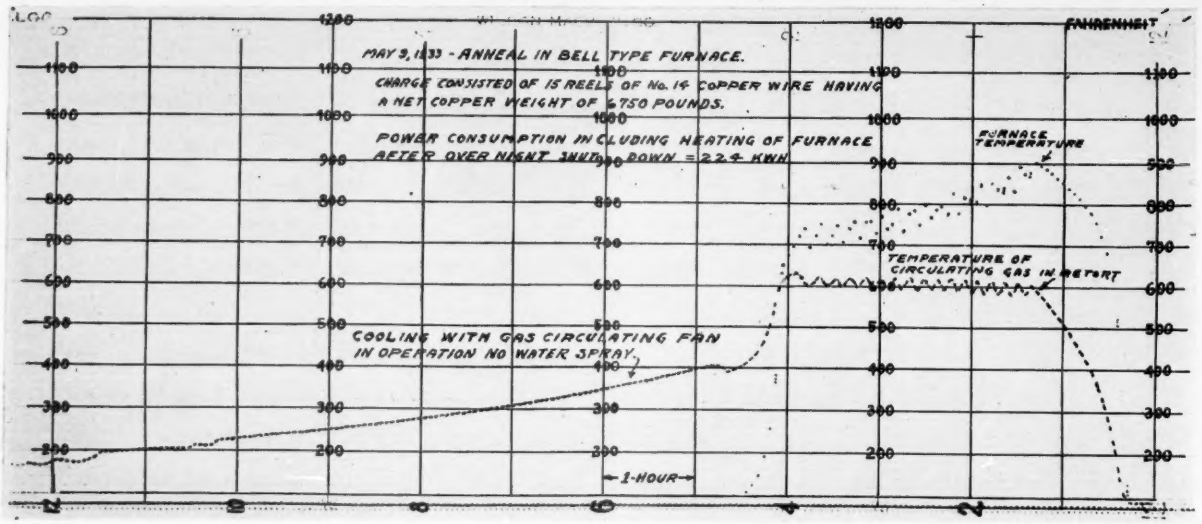
MAY 9, 1933 - ANNEAL IN BELL TYPE FURNACE.
CHARGE CONSISTED OF 15 REELS OF No. 14 COPPER WIRE HAVING A NET COPPER WEIGHT OF 6750 POUNDS.
POWER CONSUMPTION INCLUDING HEATING OF FURNACE AFTER OVER NIGHT SHUT DOWN = 224 KWH
FURNACE TEMPERATURE
TEMPERATURE OF CIRCULATING GAS IN RETORT
COOLING WITH GAS CIRCULATING FAN IN OPERATION NO WATER SPRAY
1-HOUR
FAHRENHEIT

Fig. 7—Chart record of anneal in bell type furnace.

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The Heating Chamber

THE furnace proper consists of a heating chamber with a lightweight refractory lining, which is backed by heat insulating material. The entire brickwork is encased in a welded sheet steel casing. Heat is supplied electrically to the chamber by means of nickel chromium alloy resistor ribbons which are formed into sinuous loops and are supported from refractory, insulating hangers built into the refractory lining of the furnace.

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The Base

THE furnace base consists of a circular steel platform lined with heat insulating and lightweight refractory brick, the brick lining being surrounded by a water-tight trough used for making a gas tight seal between the furnace base and the retort.

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The Cooling System

A CENTRIFUGAL type fan is located in the center of the base just above the brick lining. The fan is driven by a vertical induction motor located underneath the furnace base. An oil sealed bearing housing insures a gas tight fit where the fan shaft passes through the furnace base.

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Loading Pedestal

A LOADING supporting pedestal is located just above the fan. It is so designed that the gas inside of the retort, when the latter is in place on the base, is directed down through the charge of copper into the fan, and upward along the heated retort wall. Suitable gas inlet and outlet pipes are provided in the base.

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The Retort

THE retort is a cylindrical shell closed at top and open at the bottom. It consists of formed sheet steel welded gas tight. The

Fig. 8—Bell type electric furnace with circulating fan for bright annealing. Views showing load in position on base.

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bottom of the retort is provided with a sealing flange which meshes with the circular water trough of the furnace base.

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Use of Multiple Units

WHEN the quantity of copper to be treated is greater than can be annealed by one base and retort, duplicate bases and retorts are used. The bases are usually arranged in a row in such a manner that an overhead travelling crane or hoist may move the furnace from one base to another. The furnace bases are usually placed in a shallow pit so that the tops are slightly above floor level. This arrangement facilitates loading and unloading, and also decreases the necessary head room.

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Temperature Control

THE temperature of the furnace is controlled by a two-point, temperature control instrument operating with one thermocouple adjacent to the furnace resistors and a second thermocouple located near the charge inside of the retort. The temperature control instrument operates in conjunction with a magnetically operated power control panel which connects the furnace resistors to or disconnects them from the line in accordance with the temperature requirements of the furnace.

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Control Adjustments

THE temperature control instrument is adjusted so that a high temperature gradient may be obtained between the charge and the heating chamber, during the initial period of the heating cycle, so as to accelerate heating; the gradient to gradually decrease as the entire charge approaches the desired maximum temperature. Fig. 7 is an actual chart record taken during a production anneal. The high initial gradient followed by an automatic reduction of the temperature gradient is clearly shown. The chart also shows the definite limitation of furnace and charge temperatures to predetermined values.

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Method of Operation

THE normal method of operation is to stack the spools of wire on the furnace base, see Fig. 8, place the retort over the charge, and fill the sealing trough with water so as to create a gas tight seal between the retort and the base. All of the air trapped within the retort is removed by displacing it with a protective gas. Experience indicates that a volume of protective gas between four and five times the net air volume within the retort is necessary to purge the retort of air. The quantity required depending upon the type of protective gas and the nature of the charge. With the charge surrounded by a protective gas, the gas circulating fan is started, and the furnace placed over the retort. Current is then applied to the furnace resistors.

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Alternating Base System

DURING the heating of the first charge a similar charge may be loaded on the second base and prepared for annealing in the manner previously described. When the first charge reaches temperature the furnace is then shifted to the second charge and the hot charge allowed to cool, covered by its retort still containing a protective gas. The cooling will be greatly accelerated if the gas circulating fan be allowed to run during the cooling period. The time required for cooling depends upon the size of retort, the weight of charge, the charge temperature, room temperature and other conditions affecting the rate at which heat may be removed from the retort. If the heated charge is allowed to cool naturally, the cooling time will be relatively long. This time may be materially decreased by operating the gas circulating fan. A still further reduction of time may be obtained by means of a water spray on the outside of the retort. A better idea of the efficiency of the various methods of cooling may be obtained by reference to a specific example. The furnace shown in Fig. 8 when loaded in the manner indicated and heated to a temperature of 470° F. would require about 19 hours for the charge to cool to 100° F. if natural cooling were utilized. If the gas circulating fan is operated the cooling time would be decreased to about 8 hours. With the gas circulating fan in operation and a water spray on the outside of the retort, the cooling would be about 4½ hours.

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Utility of Equipment

HAVING considered the characteristics of copper, the conditions necessary to obtain a successful, dry, bright anneal and the design features of the bell type furnace, the utility of the equipment for the annealing process may be determined from the following data taken during normal factory operation of the equipment. The data presented has been obtained with two sizes of equipment located in separate plants. The smaller equipment operated almost entirely on fine wire and therefore utilized relatively low temperatures and retarded heating and cooling cycles so as to prevent the so-called sticking. The larger equipment operated entirely on large wire with which sticking does not normally occur.

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Operation on Fine Wire

THE small furnace, see Fig. 8, has an electrical rating of 30 kw., and loading dimensions 30 inches diameter by 40 inches high. The furnace was loaded with 30-12″ diameter by 6″ high spools containing .042″ dia. copper wire, a gross weight of 2712 lbs., and a net weight of 2250 lbs. The charge was heated from room temperature to 470 deg. F. in three and one-quarter hours. It was then allowed to cool with the gas circulating fan

in operation for one and one-half hours, at which time the temperature had dropped to 290 deg. F. A cold water spray was then applied to the outside of the retort and the cooling continued for three additional hours, at which time the temperature of the copper had dropped to 100 deg. F. The retort was then removed and the charge unloaded.

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THE total energy consumption for the annealing operation was 63 kwh., or 35.7 pounds of copper annealed per kilowatt hour of electrical energy used. During the entire annealing cycle the copper had been surrounded by a protective gas consisting of approximately 10 per cent hydrogen and 90 per cent nitrogen. The copper, when removed from the furnace after annealing, was dry, bright, and ready for labeling and forwarding to the insulating machines.

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Uniformity of Anneal

THE uniformity of the anneal may best be judged by a series of elongation tests made on wire taken from various portions of the load. The results of such tests are listed in table No. 1 and show that the percentage of elongation varied only 3.4%.

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Operation on Larger Wire

THE large bell type furnace under consideration has an electrical rating of 104 kw. and loading dimensions 49 inches diameter and 61 inches high. The complete installation consists of one furnace, two furnace bases, two retorts and a combustion type furnace atmosphere controller. The installation was so designed that all annealing operations could be carried out during an off-peak power period, so as to obtain the most favorable price for power. Because of the off-peak operation the furnace proper is only operated about 8 hours out of every 24, hence it cools considerably during the standby period. The results of an eleven-day check of energy consumption during normal production are listed in Table No. 2. Fig. 7 shows a chart record covering a half day's production annealed in one charge.

TABLE NO. 1 PERCENT ELONGATION IN TEN INCHES

Row**	Position in Spool* Top	Center	Bottom
A	28.8%	29.8%	29.7%
B	30.8	29.2	30.2
C	27.6	29.7	27.7
D	30.6	30.7	29.5
E	29.8	30.7	30.4
F	30.0	30.7	31.0

*Refers to spools lying on end.
**Refers to layers of spools stacked one on top of another, Row A being the top row.

TABLE NO. 2 ENERGY CONSUMPTION

FURNACE BASE NO. 1

Date May-1933	Reels	Size Wire	Total Wgt. Net Pounds	Temp. in Retort °F.	KWH	Pounds Per KWH.
8	13	14	7500	600	278	27
9	15	12	6750	600	224	30
10	12	12	7200	600	230	31.3
11	15	14	8700	600	228	38
12	9	14	5400	600	197	27.4
15	13	14	7800	600	240	32.5
16	13	14	6700	600	217	30.8
17	47	24	5500	500	171	32
18	15	14	8250	600	235	35
19	13	14	7800	600	206	37.8
22	13	14	7800	650	251	31

Note: Above energy consumption includes that necessary to heat furnace after overnight shutdown.

FURNACE BASE NO. 2

Date May-1933	Reels	Size Wire	Total Wgt. Net Pounds	Temp. in Retort °F.	KWH	Pounds Per KWH.
8	13	14	7500	600	172	43.6
9						
10	8	14	4800	600	145	33
11	46 small	22 24	6200	500	137	45.3
12						
15	10	14	6000	600	171	35
16	8	14	4000	600	145	27.6
17	15	Empty	1400 Reels only	780	92	
18	13	14	6550	600	173	37.9
19	8	14	4800	600	136	35.3
22	13	14	7800	600	190	41

Note: For above charges, furnace was hot; having been removed from furnace base No. 1.

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Results Under Normal Operating Conditions

FROM the data presented on the two sizes of bell type furnaces it can be seen that the following results have been obtained during normal factory operation.

(a) Copper wire was uniformly annealed.

(b) Copper wire, when removed from furnace, was clean, dry, and required no respooling.

(c) The power cost for annealing is very low since on an average more than 30 lbs. of copper are annealed per KWH. supplied to the furnace.

(*Please turn to page 92*)

Production of Bolts, Nuts, Screws and Rivets

By J. B. Nealey
American Gas Association

A description of the production methods of the Pittsburgh Screw & Bolt Co. with particular reference to use of gas as fuel for their heat treating operations.

THE world's largest manufacturer of bolts, nuts, rivets and screws is said to be the Pittsburgh Screw & Bolt Company with plants in Pittsburgh, Neville Island, Morristown and Monaca, Pennsylvania, Gary and Hammond, Indiana, and Chicago, Ill. The largest of these is the Pittsburgh Works where more than 6,000 tons are produced monthly. This company manufactured all the bolts and rods used in the construction of the Panama Canal—most of the armor plate bolts for the United States Navy and all the bolts for the New York-New Jersey vehicular tunnel under the Hudson River. Bolts ranging from ¼″ and ½″ up to 6″ in diameter and 25′ to 50′ long are made here.

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THE Hudson River tunnel job called for 5,000 tons of nuts and bolts 8″ long and 1¾″ in diameter of a special chrome nickel steel, heat treated to produce a minimum tensile strength of 125,000 pounds to the square inch. Rods 20 to 30 ft. long, threaded at both ends and twisted are being furnished by this concern for the gigantic water tunnel being driven under New York City. They are used spirally as reinforcing in the concrete walls of the tunnel and the working caissons.

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Material Handling

THE main building of the Pittsburgh Plant is very long and has three bays. Railroad tracks, close to the walls of the outer bays, bring the stock in on one side and remove the finished products from the other, cranes handling material across the plant during processing. Two long rows of steel bins, one on each side of the middle bay, act as a reservoir for the ebb and flow of processed material on the one hand and storage, prior to packing and shipping, on the other. Kegs and other material are distributed throughout the plant on belt type conveyors.

Routing Material

THE machines and furnaces are so located in the different bays that the work flows in a straight line from one side of the plant to the other. For instance, nuts are blanked in automatic machines on one side of the plant, dumped into the first row of bins and fed from these into a row of tapping machines in the middle bay and are then dumped into the second row of bins. The same system is provided for movement of material between the bolt heading and roll threading machines. Cans handled by cranes are used.

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Cold Heading Department

THE cold heading department includes a battery of automatic machines to which the material is fed in the form of large coils of drawn wire and without heating. The bolt sizes are, of course, in the smaller brackets. These machines shear, head and eject continuously.

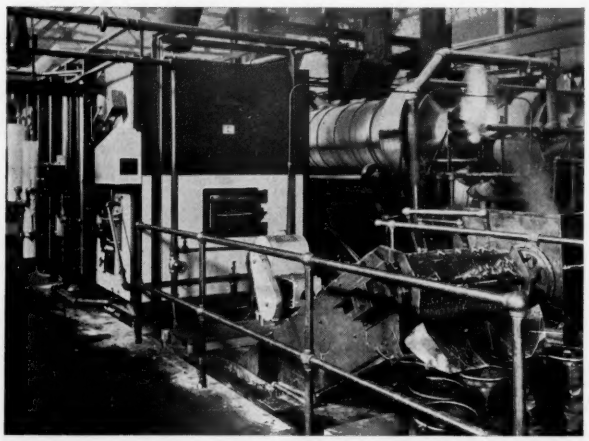

Fig. 1—Automatic gas-fired heat treating furnace with belt conveyor. Note quench and flight conveyor in foreground. (Rotary gas fired furnaces at right). ✦ ✦ ✦ ✦ ✦ ✦ ✦

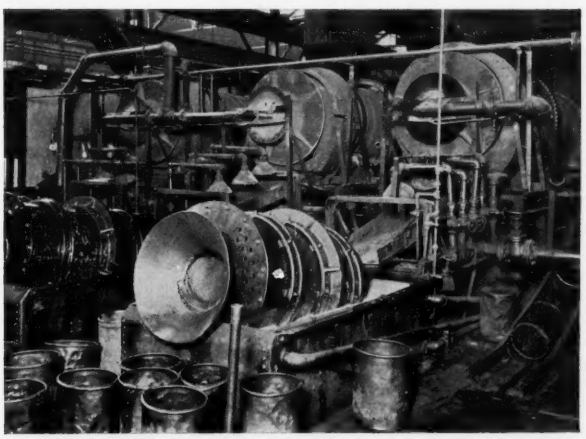

Fig. 2—Gas fired rotary annealing furnaces that are automatic and continuous both as to temperature control and operation. ✦ ✦

End Forging Division

THE end forging division has 30 slot type gas fired furnaces of which two are equipped with motor operated conveyors for moving the work across the front with one end of the steel projecting into the furnace through the slot. The conveyor consists of two looped chains suspended between four sprockets, the sprockets being adjustable so as to regulate the distance between the chains for different length rods.

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The Furnaces

THE furnaces have 10 ft. hearths and the conveyor extends some 3 ft. beyond for loading. This conveyor is loaded manually and the hot stock is discharged onto the table of a semi-automatic heading machine at the other end. Heat is supplied to each furnace by 6 gas burners located in the front wall and underfiring the work.

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WHILE these end forge furnaces are of the slot type they otherwise vary somewhat in design and method of firing. Most of them have 60 in. hearths and consist of steel plates bolted together into a case which is lined with fire-brick. They stand on legs to bring the slot to a convenient level for the operator who is protected from the heat by a water cooled shield and a forced draft to eliminate the heat radiating from the furnace slot.

✦ ✦ ✦

Burners

MOST of these units are fired with three nozzle mixing gas burners each, a burner consisting of two pipe like castings one within the other. Air forced at 1½ lbs. pressure, through the inner casting, entrains gas at 6 oz. in the outer casting, by means of perforations in the wall of the inner casting. The proportion of gas and air is regulated by valves so as to provide complete combustion. One motor driven blower

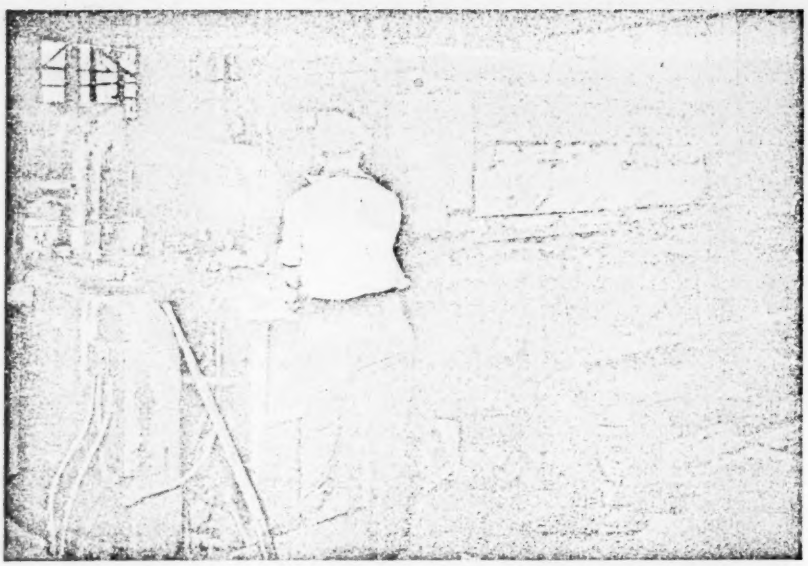

Fig. 3—Forge furnace fired from top. Conveyor moves work across front for end heating and to hot heading machine adjacent. ✦ ✦ ✦ ✦ ✦ ✦ ✦ ✦

furnishes air for a number of these furnaces through one long duct with a takeoff duct to the air manifold of each furnace. Upsetters in this group have a capacity for 800 pieces of one in. stock or 1,000 pieces of ⅝ in. material per hour.

✦ ✦ ✦

Improved Firing Methods

WHILE the end firing method of heating these furnaces predominates, a novel improvement has been introduced in 2 or 3 by placing the burners in the top, so that they fire straight down on the work. The height of the burners is so regulated that the hottest part of the flame is in direct contact with the work. The combustion chamber is designed with a minimum space so as to bring the maximum heat radiation onto the work and at the same time cut radiation losses to a minimum by reducing the area of the radiating walls.

✦ ✦ ✦

THE burners of these top fired furnaces are of the premix blast type and this method of firing has shown a considerable saving in fuel consumption with equal

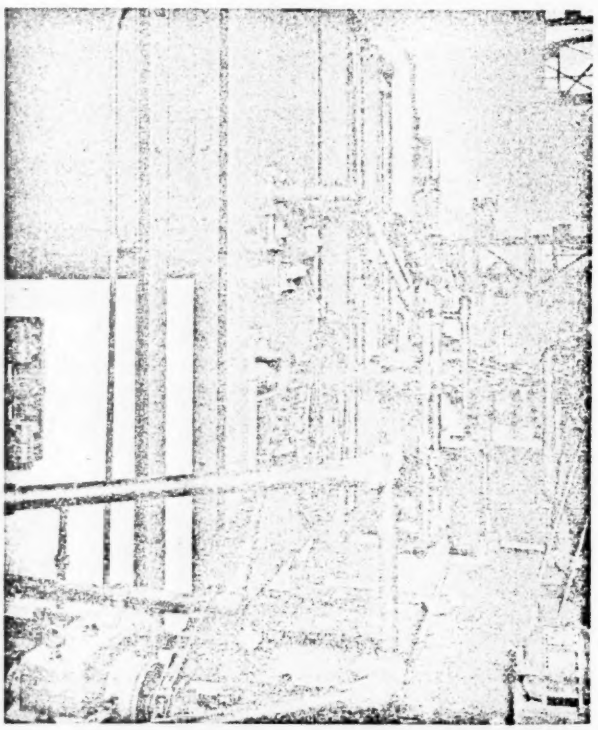

Fig. 4—Gas firing system and automatic temperature controls of heat treating furnace. ✦ ✦ ✦ ✦ ✦ ✦

performance over furnaces in which burners of the same type were located in the back wall. While there are other furnaces in which the burners are placed in the rear wall, they give very satisfactory service. One of these is for very large work, has a 9 ft. hearth and is fired with three gas burners. It, too, is of the slot type. The ends of rods more than 50 ft. long have been heated in this furnace for upsetting.

✦ ✦ ✦

Heat Treating Department

IN the heat treating department are four rotary gas fired furnaces each 20 ft. long and 4 ft. in diameter. An inside helical screw causes the work to progress through as the furnace revolves while a single gas burner in the discharge end furnishes heat on the counterflow principle. A conveyor brings the material in and an elevator hoists and dumps it into the furnace while an 8 ft. slide permits it to roll by gravity from the discharge end into the quench tank. Water from four sprayers is forced by centrifugal pumps onto this work (30-40 lbs. pressure) as it moves to the tank. The quench tank is provided with a rotating perforated steel cylinder, set at an angle and this moves the work through the quench and discharges it over the end into tote boxes for further handling.

✦ ✦ ✦

Special Furnace for Hardening and Drawing

THERE has just been erected in this division, a heat treating furnace, that is used alternately for hardening and drawing. It is of the continuous belt conveyor type, brick and steel construction, 21 ft. long, 8 ft. wide and 9½ ft. high. There are two chambers, one into which the gas burners fire from the sides, being located directly above the other in which the work is heated. They are separated by an arch and the hot products of combustion pass down through ports.

✦ ✦ ✦

THIS heat continues its passage down through the work and alloy mesh conveyor into ducts in the side walls and are exhausted to a stack. Heat is supplied by eight gas burners on one side and two on the other, all firing into the combustion chamber. Two supplementary burners fire directly into the heating chamber.

✦ ✦ ✦

Control of Firing System

THE firing system is controlled in two parts so that the heating furnace naturally divides off into two zones, preheat and high heat. This is accomplished by manifolding the burners in two sets and applying an automatic temperature controller to each. Air is furnished by a blower at 1½ lbs. pressure and this inspirates zero gas at the burners. The controllers, of the potentiometer type, are connected to motor operated valves cut into the two air manifolds. The two burners on one side of the furnace are piped to one of the manifolds on the opposite side where the other eight are located. One indicating and one recording pyrometer are provided for the preheat and high heat zones respectively.

✦ ✦ ✦

THE discharge end of the furnace is closed, the work dropping through an opening in the hearth, through a chute, directly into the quench tank located below in a pit.

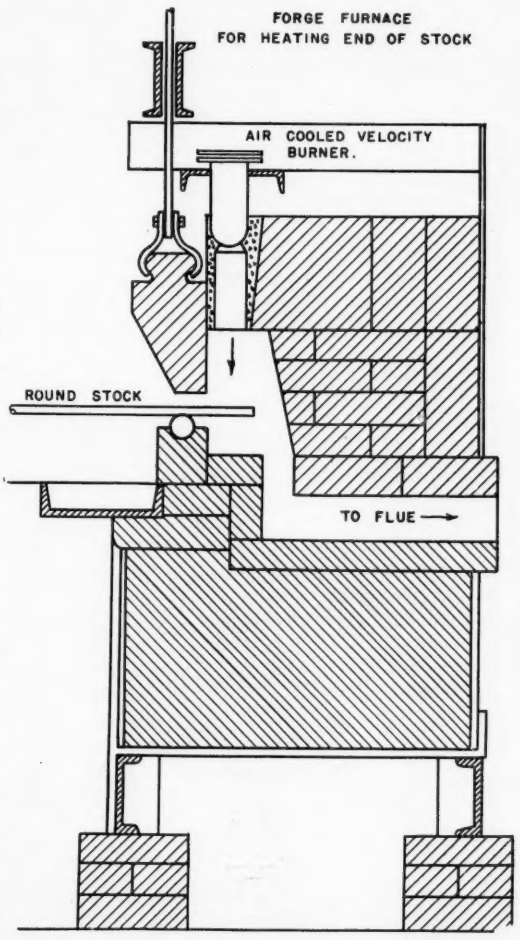

Fig. 5—Forge furnace fired from top.

✦ ✦ ✦

Quench Tank

THIS is a steel tank 12 ft. long, 5 ft. wide and 4 ft. deep and is equipped with a motor driven flight conveyor which moves the work up over the far edge where it drops into tote boxes for further handling. Oil, water or a soda compound can be used for the quenching medium in which case the chute forms an air seal. If the work is to be drawn only, the liquid is removed from the tank and the operation of the furnace is the same as before, except that a lower temperature and a different time cycle are employed. Both the oil and soda compound are pumped to the quench tank from separate storage tanks and returned after using. The water is also pumped in but is wasted after using.

This furnace is capable of hardening material at the rate of 1,500 lbs. hourly with a gas consumption of approximately 1,500 cu. ft.

(*Please turn to page 91*)

A Review of Recent Wire Patents

No. 1,939,552, CONDUCTING WIRE, Patented December 12, 1933, by Eugen Hepner, Berlin-Wilmersdorf and Hans Meurer, Cologne-on-the-Rhine, Germany, assignors to the firm Jaroslaw's Erste Glimmerwaren-Fabrik in Berlin, Berlin, Germany.

The assembly includes an outer covering separated from the interior conductor wire by means of spaced apart distance pieces forming an air insulation between the inner and outer conductors. In the disclosure, the distance pieces comprise a plurality of spaced apart wooden or glass beads strung upon the inner conductor wire.

✦ ✦ ✦

No. 1,939,643, SCREW THREAD GAUGE, Patented December 19, 1933, by Robert O. Beardsley, Springfield, Vt., assignor to Jones & Lamson Machine Company, Springfield, Vt., a corporation of Vermont.

This gauge is adapted to show errors in the pitch diameter of screws and is stated to be employed in conjunction with the gauge provided by the invention for showing errors in lead over a predetermined number of turns of a screw thread.

✦ ✦ ✦

No. 1,939,875, CABLE, Patented December 19, 1933, by Vannevar Bush, West Medford, Massachusetts.

This inventor provides a flexible material next to the sheath of an electrical cable for the purpose of absorbing the pressure exerted by expansion of the oil against the sheath.

✦ ✦ ✦

No. 1,940,225, ELECTRIC CABLE, Patented December 19, 1933, by Frederick Palmer and John E. McAuliffe, Brooklyn, N. Y., assignors to Triangle Conduit Company, Inc., Brooklyn, N. Y., a corporation of New York.

The inventor provides an armored cable having a device at its end to insert a bushing between the paper wrapped insulated conductors and the end of the armor to protect the conductor.

✦ ✦ ✦

No. 1,940,511, HIGH VOLTAGE CONDUCTOR, Patented December 19, 1933, by Harold D. Rice, Bristol, R. I., assignor to National India Rubber Company, Bristol, R. I., a corporation of Rhode Island.

The wrap for this conductor comprises latex paper and a packing of folded and crushed latex paper between and around the wrapped conductor.

✦ ✦ ✦

No. 1,941,098, SEALED WIRE ROLL AND METHOD OF MAKING SAME, Patented December 26, 1933, by Paul L. Mann, Chicago, Ill., assignor to Consolidated Wire & Associated Corporations, Chicago, Ill., a corporation of Illinois.

Provision is made for sealing the ends of a roll of stranded wire together with the seal bearing indicia as to the size and kind of the wire in the roll.

✦ ✦ ✦

No. 1,941,882, WIRE SPRING FABRIC, Patented January 2, 1934, by Charles J. Elder, Brooklyn, N. Y.

Complete Descriptions and Drawings of Patents May Be Had for 25 cents. Address, Wire & Wire Products, 17 East 42nd St., New York.

More particularly, this fabric relates to that employed in wire bed bottoms, the invention covering a self-locking helical spring for connecting the top coils together.

✦ ✦ ✦

No. 1,941,913, ELECTRIC CABLE, Patented January 2, 1934, by Thomas Nixon Riley, London, England, assignor to International Standard Electric Corporation, New York, N. Y.

More specifically, the invention has to do with cables having impregnated fibrous dielectrics and comprises a method of impregnating the same consisting of applying a vaporizable material to the conductive core, surrounding the core with insulation, subjecting the insulating core to a drying operation under predetermined diminishing pressure and at a predetermined temperature, raising the temperature and decreasing the pressure and then introducing the impregnating medium, the impregnating medium being preferably menthyl napthalene.

✦ ✦ ✦

No. 1,942,069, APPARATUS FOR CUTTING WIRE INTO LENGTHS, Patented January 2, 1934, by Kazuo Setoguchi and Matayasu Sakurai, Tokyo, Japan, assignors to General Electric Company, a corporation of New York.

This apparatus is adapted particulraly for cutting wire filaments for lamps and includes electric means for securing automatic operation of the machine as well as adjusting means for regulating the length of cut.

✦ ✦ ✦

No. 1,942,113, COIL WINDING MANDREL, Patented January 2, 1934, by John G. Meyers, Rome, N. Y., assignor to General Cable Corporation, New York, N. Y., a corporation of New Jersey.

Covered by this patent is an expansible and collapsible mandrel for making layer wound wire coils, the first turn being made according to a predetermined plan and the other turn laid in grooves between the turns.

✦ ✦ ✦

No. 1,942,249, APPARATUS FOR PRODUCING WIRE STAPLES IN COHERENT STRIPS, Patented January 2, 1934, by Oscar Kleinschmit, Leipzig-Plagwitz, Germany, assignor to Gebruder Brehmer, Leipzig-Plagwitz, Germany, a firm of Germany.

It is stated that this apparatus will produce staple strips which will not warp during drying.

✦ ✦ ✦

No. 1,942,321, SUBMARINE CABLE, Patented January 2, 1934, by George Zapf, Cologne, Germany, assignor to Felten & Guilleaume Carlswerk Actien-Gesellschaft, Cologne-Mulheim, Germany.

Specifically, the patentee has provided a pressure-protecting casing or tubing made up of profile wires which are stranded together around the wire cable cores, the wires of the casing being formed with tongues and grooves for interengagement with each other and pressed into interlocking relation with each other.

✦ ✦ ✦

No. 1,942,451, WOVEN WIRE AND METHOD OF PRODUCING THE SAME, Patented January 9, 1934, by Elmer D. Reynolds, Dixon, Ill., assignor to Reynolds Wire Co., Dixon, Ill., a corporation of Illinois.

The method of producing this wire cloth includes weaving wire of a diameter less than .02 of an inch into cloth of less than 12 mesh and heating the cloth in a temperature within the bluing range of steel for a sufficient length of time to relieve the strains in the wire.

✦ ✦ ✦

No. 1,942,550, HEAT TREATMENT OF CABLES, Patented January 9, 1934, by Ralph O. Helgeby, Flint, Mich, assignor to A C Spark Plug Company, Flint, Mich., a company of Michigan.

The cables referred to are those employed particularly in driving speedometers, the heat treatment being to remove stiffness and internal friction from the flexible cable and consists in passing the cable thru a heated furnace having a temperature of about 560°C. at its entrance, about 510°C. at its entrance, about 510° at its middle and about 570° at its end.

✦ ✦ ✦

No. 1,942,670, FORMING AND BREAKING HEAD FOR WIRE ROPE STRANDERS AND CLOSERS, Patented January 9, 1934, by William E. Somerville, Coal City, Ill.

Means is provided whereby the length of a turn and the form of the helices intermediate the forming heads or dies may be varied.

✦ ✦ ✦

No. 1,943,087, ELECTRICAL CABLE AND METHOD OF MANUFACTURE, Patented January 9, 1934, by Frank M. Potter, Rome, N. Y., and Edgar W. McKnight, Bayonne, N. J., assignors to General Cable Construction, New York, N. Y., a corporation of New Jersey.

These inventors aim to provide a wire cable having a smooth outer surface, free of deep valleys, the cable being so formed due to compacting together of the strands.

✦ ✦ ✦

No. 1,943,347, SPRING STEEL, Patented January 16, 1934, by Joseph Kent Smith, Detroit, Mich., assignor to The Beryllium Corporation, New York, N. Y., a corporation of Delaware.

This spring steel is made up of about 0.30% to about 5% beryllium, about 0.35% but not more than 1.5% molybdenum, about 1% but not more than 1.5% chromium, about 0.35% but not more than 0.50% carbon, about 1% but not more than 1.5% manganese, and the balance iron.

Exports and Imports of Wire

Exports of Iron and Steel Wire Products in Dec. 1933 and Dec. 1932
(In gross tons)

	Dec. 1933	Nov. 1933	Dec. 1932
Wire rods	3,210	2,062	1,103
Hoops, bands and strip steel	914	1,246	510
Plain black or galvanized iron or steel wire	3,346	2,870	731
Barbed wire and woven wire fencing	3,545	3,173	1,348
Woven wire screen cloth	98	36	43
Wire rope	232	372	123
Insulated iron or steel wire and cable—see analysis below			
Other wire and manufactures	316	253	194
Wire nails	1,115	984	701
Tacks	43	58	41
Other nails, including staples	272	185	200
Bolts, machine screws, nuts, rivets and washers	441	357	307
Total, these 11 classifications	13,532	11,596	5,301

Imports of iron and steel wire and wire products into the United States
(In gross tons)

Concrete Reinforcement bars	116	479	905
Hollow bars and drill steel	102	118	73
Merchant steel bars	2,082	2,026	1,711
Wire rods	1,143	778	1,149
Barbed wire	1,385	389	521
Round iron and steel wire	192	458	105
Telephone and telegraph wire	1		3
Flat wire and strip steel	134	150	91
Wire rope and strand	201	163	146
Other wire	111	125	123
Hoops and bands	1,267	1,682	1,777
Nails, tacks and staples	324	651	1,051
Bolts, nuts and rivets	27	26	26
Total, these 13 classifications	7,085	7,045	7,681

Exports of Insulated Wire and Cable

DECEMBER, 1933

	Lbs.	Value
Insulated iron or steel wire and cable	1,758	$ 918
Rubber covered wire	196,949	42,598
Insulated copper weatherproof wire	160,032	24,262
Wire and cable telephone cable	31,529	5,809
Other insulated copper wire	667,864	106,645
Nickel-Chrome Electric	18,147	19,721
Total, these 6 classifications	1,076,279	$199,953

THERE were 184,585 gross tons of iron and steel products exported in December, the largest tonnage exported in any single month since May 1930. The December trade exceeded that of November by 26,985 tons. The rise in scrap shipments, 15,380 tons, was the principal gain of the month, but other increases contributing appreciably to the new high included those in galvanized steel sheets, 3,854 tons, in tin plate, 3,324 tons, in non-fabricated plates, 1,508 tons, in steel bars, 1,151 tons, in wire rods, 1,148 tons and in galvanized wire, 1,117 tons.

✦ ✦ ✦

JAPAN was, of course, the month's largest buyer of American iron and steel, her total of 76,363 tons including 67,772 tons of scrap and 2,623 tons of wire rods. Canada took the second largest quantity, 16,710 tons, in which is included 8,616 tons of scrap, 1,086 tons of steel bars, and 1,066 tons of black steel sheets. Third place went to Brazil with a total of 13,694 tons including 3,997 tons of heavy and 2,239 tons of light rails and 2,443 tons of rail joints. Italy, with scrap making up 10,611 tons of the 12,177-ton total, was the fourth largest market of December, while the United Kingdom, with 5,709 tons of the 6,414-ton total also scrap, was the fifth market.

✦ ✦ ✦

ENDING the two-months-long downward trend which had characterized the import trade of the United States in iron and steel, products, December with its total of 31,310 gross tons was superior to that of November by 2,331 tons. Credit for this improvement is due entirely to pig iron, receipts of which rose 11,452 tons from the abnormally small trade of November. The only other gain of consequence was that in barbed wire, 996 tons. Pig iron was, in point of tonnage, the leading item in the month's trade, and was followed by ferro-manganese and spiegeleisen, structural shapes, merchant steel bars, barbed wire, and hoops and bands in that order.

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THE Netherlands' total of 7,373 gross tons and that of British India, 6,936 tons, were the leading items in the month's trade—the entire quantity in each instance being pig iron. Belgium was third with a total of 5,327 tons of which 1,855 tons was structural shapes, 1,445 tons was merchant steel bars, and 992 tons was hoops and bands. Ferro-manganese, 2,338 tons of it, featured the Canadian trade of 3,711 tons, while of the German total of 3,266 tons 1,173 tons was barbed wire.

✦ ✦ ✦

CARD clothing receipts were somewhat increased in December—to 26,099 square feet valued at $32,852, 23,866 square feet ($26,881) coming from the United Kingdom, 2,194 square feet ($5,707) from Germany, and 39 square feet ($264) from Switzerland.

✦ ✦ ✦

WIRE cloth and screening imports also declined, the total of 24,098 square feet including 15,235 square feet from Canada, 3,525 square feet from France, 2,835 square feet from Germany, and 2,500 square feet from the Netherlands.

✦ ✦ ✦

FOURDRINIER wire imports, down to 42,611 square feet in November, rose to 127,207 square feet in December with Austria supplying 108,721 square feet, Sweden 11,723 square feet, Germany 4,015 square feet, and France 2,748 square feet.

✦ ✦ ✦

THE wire fencing and netting trade was sharply increased in December. Of the fencing, etc.,

(*Please turn to page 94*)

'Round the World With the Wire Industry

British Rope Combine's Earnings Higher

PRESIDING at the annual meeting of British Ropes, Ltd., the big British wire rope combine, which was recently held in London, Colonel J. J. Gillespie, the chairman, revealed that the profits for the past year had risen to £62,935 ($314,675) or £14,500 in excess of those of the previous year. The profits were the highest the enterprise has earned since 1929.

"The past year has not been an easy one," declared Colonel Gillespie, "trading conditions having been particularly difficult in the earlier months. The closing months of the company's financial year, however, gave distinct evidence of better trade.

"With regard to the question of reconstruction, I do not think it is an opportune time for dealing with the £744,000 ($3,720,000) first mortgage debenture stock, which falls due for repayment in November, 1935. The directors ask the shareholders to wait a little longer and hope that this time next year will show us further advanced along the road to recovery."

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Sheffield's New Wire Industry Prospering

THE works of Tinsley Wire Industries, Ltd., which were completed in Sheffield recently and which have provided the British steel center with a new industry in the manufacture of barbed wire, wire netting, and other forms of wire fencing, are having a very busy time. The new enterprise is receiving plenty of orders, partly due to the revival in the heavy industries and partly an illustration of the fact that such an industry was badly needed in this steel center.

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ANOTHER new industry, in the success of which wire plays a part, has been built up in Sheffield during the past three or four months around a process which offers permanent protection against corrosion by heat, acids, or atmospheric conditions. By this method, which is employed by Universal Metal Sprayers, Ltd., the article under treatment is first sand-blasted and then metal is sprayed on it in any thickness of coating by means of a spray pistol. Whatever metal is required is introduced into the pistol in the form of wire and turned into the molten state in the nozzle from which it is sprayed.

✦ ✦ ✦

Mexico To Modernize Telegraph Lines

THE entire national telegraph net of Mexico is to be modernized with copper wires and teletype machines. It is proposed to use Mexican copper refined in bond in the United States and manufactured into wire by a new plant at Mexico City.

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Two New Wire Nail Factories Opened In Egypt

AS an example of the *Egyptian* Government's endeavors to foster local industries two small wire nail factories have recently been established, equipped with German machinery. These have been promised the help of the Government, as far as erecting customs barriers on imported nails is concerned, should they meet with success. Necessary wire is to be imported from Europe, but difficulties are being experienced in obtaining this material. Efforts are now being made to obtain nail wire from the United States.

✦ ✦ ✦

New Plant At Tel-Aviv., Palestine

A NOTE from the American Consul at Jerusalem states that the Orient Iron Works, which is the first factory in *Palestine* for the manufacture of screws, nuts and rivets is being established in Tel-Aviv. The manager of the factory is reported to be an experienced German, who has spent many years in the iron and steel industry.

✦ ✦ ✦

Belgian State Telegraph Budget

FOR the fiscal year beginning March 1, 1934, the budget of the Government Telegraph and Telephone Monopoly provides for expenditures of 710,000,000 francs, of which 68,000,000 francs are destined for capital expenditures on new installations and equipment, as reported in the local press. On the basis of recent experience, receipts are expected to balance expenditures for that particular department.

✦ ✦ ✦

Independent Mill Joins IWECO

ANOTHER independent mill has just joined the IWECO. The TOMADO Fabrique d'articles en fils, Dordrecht.

Belgium and Holland are actively competing against the IWECO by selling wire nails and various steel wire products at reduced quotations. It is not exactly known, how great the capacity of these works are, but it is believed to be in the neighborhood of 800 tons monthly.

✦ ✦ ✦

German Exports

THE position on the export market is such, that while prices for the different products have been maintained, nails are proving to be an exception. The IWECO had been forced to cut prices for nails by another s 3/ per ton. In this product Italian competition is now felt rather seriously. Italy is now exporting up to 1500 tons of wire products per month, wire nails constituting the largest proportion. Italy is well

placed for the Trade in the Near East, but is selling also for the Far East.

+ + +

German Domestic Sales

ACCORDING to the publication of the German wire cartel, Germany's sales of wire products for the domestic market improved in 1933 by 22%, whereas export business declined by 16%.

+ + +

Russia Buys Machinery

RUSSIA is inquiring for heavy quantities of wire machinery. German machinery companies estimate that the total value of wire machinery, which has to be bought by the Russians amounts to 28 Million Gold dollars. But it is doubtful if Russia can spend this sum.

The very bad quality of Russian shipments is due to the unsatisfactory quality of the Russian wire products. In the first place wire nail machinery must be imported and in the second wire rope making machinery. No wire machinery is produced in Russia, except certain classes of wire nail presses but only large ones, no small ones.

+ + +

German Wire Cartel

THE amalgamation between the old German wire cartel and the outsider cartel (Freie Vereinigung der Drahtwerke) will probably be carried through during March. There will then be no outsiders.

+ + +

German Wire Industry May Subsidize Exports

A PROJECT is under consideration, which would mean the institution of two classes of wire manufacturers. One producing only for export, and one producing only for domestic demand. Up to now every manufacturer was producing both for domestic and export purposes. As the products made for export are different from the domestic products it is obvious that a maker only specializing in one class of products could materially reduce his production costs. Such a division however has not been possible up to this time, because the export prices are so much lower than the domestic prices and manufacturers working only for export would as a consequence suffer greatly. However a clearing account will be established, to which the domestic products makers will pay a certain sum per ton, this to be distributed on the makers producing for export. Amongst the export makers a second division may be established which could contract the distribution of products to the various countries to which the goods would be exported.

+ + +

Polish Steel Industry Gets Additional Benefits from Cartel

THE German-Polish Steel Cartel has agreed to allow the Polish steel industry a contingent in the rolled steel sales in Germany amounting to 0.7 per cent of the total. This ratio will obtain until May 15, 1937, being reduced to .05 per cent thereafter. However, the total participation of Poland in the German market is limited to 2,100 metric tons annual, 10 per cent less than before January 1st. The agreement also provides that German scrap is to be delivered to Polish buyers at better prices—21 per cent of the purchases to be priced to Polish buyers at the same rate as is charged to users in German Upper Silesia. Finally, except for certain special products the Polish market is reserved to the steel industry of that country (as far as Germany is concerned).

China's Iron and Steel Imports Rise

IMPORTS of iron and steel products into China in 1933 exceeded those of 1932 by approximately 38,000 tons or 12 per cent—the larger gains being in black sheets and plates and in tin plate. American participation varied during the year from 7½ per cent over the first quarter to 5 per cent in June and then climbed by October to 12½ per cent and since that month have risen still higher. Competition from Japan is strong in black and galvanized sheets while Continental producers compete chiefly in mild steel bars. Another promising development in the Chinese market is the growing use of steel frame construction.

+ + +

Hugh Electric Cable Contract Placed

A CONTRACT valued at over $1,000,000 has been placed by the Southern Railway Company, London, with the Pirelli-General Cable Works, Ltd., Southampton, for the supply of electrical cable and accessories, comprising 160 miles of auxiliary cable and 77 miles of 33,000-volt main cable, chiefly required in connection with the extension of the Southern Railway's South Coast electrification. This is one of the largest individual railroad cable contracts ever placed by a British railroad.

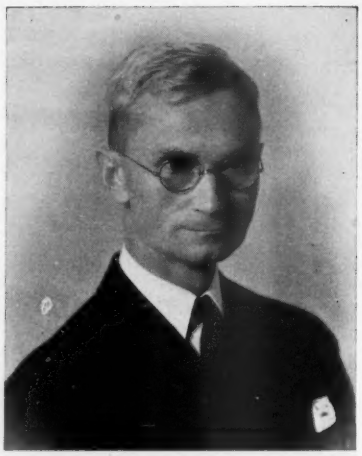
+ + +

INFORMATION is available through the office of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C., on an opportunity to sell wire rope and cable at Shanghai, China. In requesting these data please mention the number (7037) of this trade opportunity.

Outstanding Personalities of the Wire Industry

MR. L. R. CALVERT has been appointed Works Engineer of the Westinghouse Lamp Company, according to a recent announcement by H. S. Black, Manager of Manufacturing and Engineering. Mr. Calvert succeeds to the position held by the late E. J. Smith to whom he was an assistant for a number of years.

Following the completion of a special course at the University of Virginia in 1907, L. R. Calvert worked in the Engineering Department of the District of Columbia until 1916. During these years he took a special course at George Washington University. After government service with the Emergency Fleet Corporation during the World War, Mr. Calvert became Works Engineer for Flood & Conklin, paint manufacturers of Newark, N. J. In 1922 he joined the Works Engineering staff of the Westinghouse Lamp Company at Bloomfield, New Jersey, and in 1927 became Assistant Works Engineer.



L. R. CALVERT
Works Engineer
Westinghouse Lamp Company.

In assuming his new responsibilities Mr. Calvert also succeeds to Chairmanship of the Manager's Policy Committee on safety matters. This work is in line with what he has done for years as supervisor of safety activities for the Equipment and Development Division at Bloomfield. Mr. Calvert has long been a staunch supporter of industrial safety and under his guidance the good safety records achieved in the plant of the Westinghouse Lamp Company, under E. J. Smith, are expected to be maintained.

Mr. Calvert's headquarters are to be in Bloomfield, but plant maintenance of all company manufacturing properties, including factories in Belleville and Trenton, N. J., will come under his direct supervision.

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Precision Welding Machines

Various Capacities—For All Metals
No. 30 Wire to 3/4" Wire

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PUT YOUR WELDING PROBLEMS IN OUR HANDS

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MICRO PRODUCTS COMPANY
20 NORTH WACKER DRIVE, CHICAGO, ILL.
Telephone State 7468 General Offices and Factory, Peoria, Ills.

Hollow Core Bare Transmission Cable

(*Continued from page 74*)

THE stresses set up in this machine are extraordinary not only because of the heavy reels carried in the cradles but because of the tremendous pull of 25 tons required to pull the cable through the closing head. The capstan is approximately eight feet in diameter thereby avoiding setting up any unusual stresses in the cable during the cabling operation.

✦ ✦ ✦

Reel Handling Device

A SPECIAL slow-motion device is provided for loading the cradles and the use of all monorails and hoists has been eliminated by the ingenious device of rolling the reels onto a truck and directly into the loading position of the cradles. This has eliminated the hazard to the operator of having to lift extremely heavy reels and adjust them while securing them in position in the cradles.

✦ ✦ ✦

IT is interesting to note that every bearing in this machine is anti-friction in type, including the enormous bearings which hold the main tube supporting the cage. The machine can readily be turned by hand, but due to the fact that while loading the cage it is unequally balanced, automatic electric brakes are provided to prevent its getting away and injuring an operator. The machine, as in the case of the wire drawing machines, is largely built up of welded steel sections with superimposed castings forming the main housings for gears and shafts and bearings, all of which run in oil. Helical gears are generally used thus insuring quiet smooth operation. Alloy steels are used where necessary and the main bull gear is designed to stand a tooth load of 40 tons.

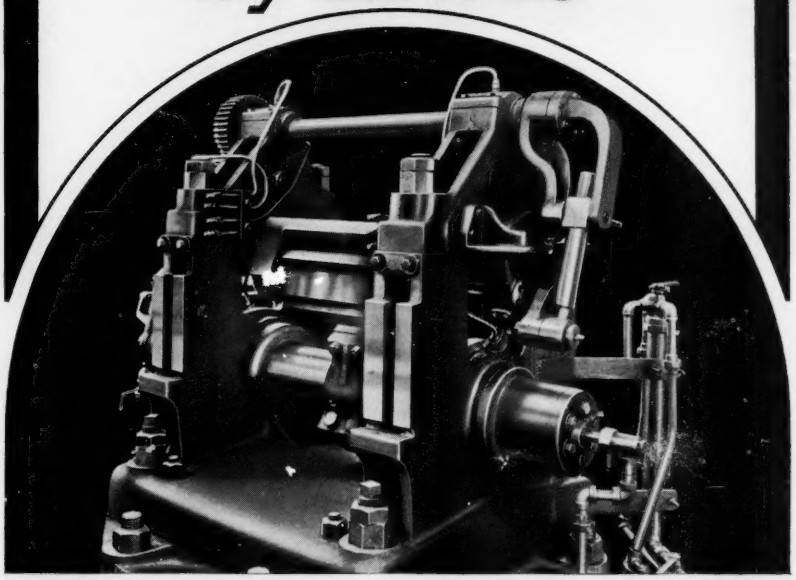
✦ ✦ ✦

Cleaning and Washing Finished Cable

THE finished capstans have a dead smooth surface to pre-

(*Please turn to page 90*)

FLYING SHEAR
by LEWIS



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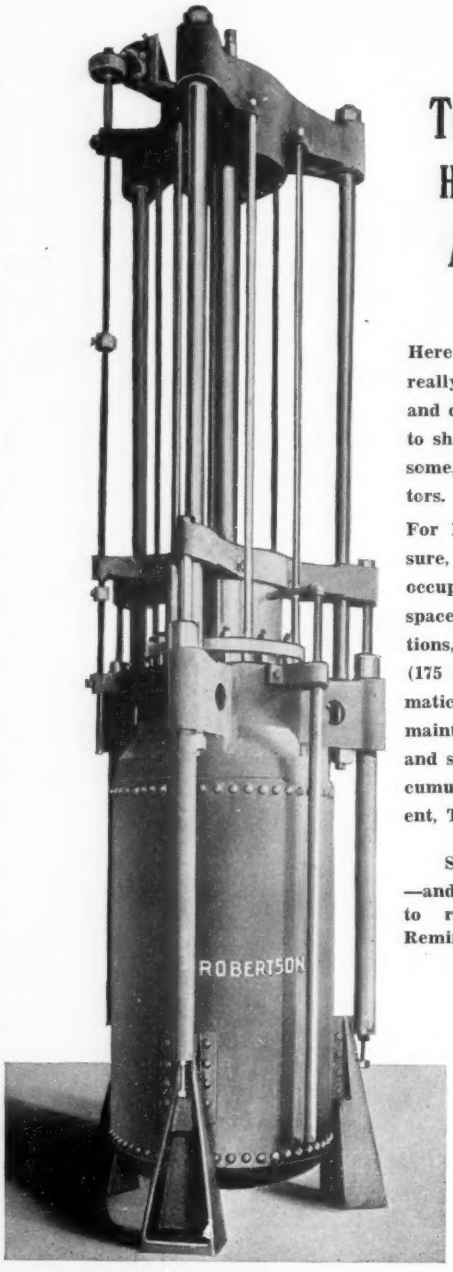


Here is an Accumulator which is really so revolutionary in design and construction that it really "puts to shame" the old types of cumbersome, slow, space taking accumulators.

For 1500-6000 lbs. Hydraulic Pressure, the Robertson Accumulator occupies the very minimum of space,—requires no heavy foundations,—operates at low air pressure (175 lbs.),—is equipped with Automatic Auxiliary Compressor (which maintains pressure in the cylinder and storage tanks). Finally, an accumulator that always gives Efficient, Trouble-free Service.

SEND FOR LITERATURE

—and ask to be put on our mail list to receive regularly—"Robertson Reminders".

Note: Robertson makes all types of lead-encasing machinery required by rubber hose and electrical cable makers: Extrusion Presses, Hydraulic Pumps, Melting Furnaces and Pots, Dies and Cores, also Lead Sheath Stripping Machines, and Hydro-pneumatic Accumulators.

Robertson lead encasing equipment is virtually a standard thing here and abroad, where in many cases it is used exclusively.

John ROBERTSON CO. INC.

Pioneers~Since 1858

125-137 Water Street Brooklyn, N. Y.

Hollow Core Bare Transmission Cable

(*Continued from page 89*)

vent marring the finished cable, the surface of which must be smooth in order to insure against corona loss in the finished cable. During the cabling operation a lubricant has to be used in the closing head and an excessive amount of the lubricant on the finished cable would be objectionable. In the cabling equipment is incorporated a special washing machine which operates to cleanse the cable, as it travels from the closing head to the cable machine capstan. This device is electrically driven and is designed to force chemical cleaning solution around the cable. Rotary brushes are employed in addition to the chemical solution and jets of hot water are played upon the cable to remove any trace of cleaning solution.

✦ ✦ ✦

Winding Cable On Steel Reels

AFTER this operation the finished cleaned cable is wound upon steel reels of special design in mile or half mile lengths. To facilitate the erection of the cable in the field specially designed connectors are attached to one end of the finished length of cable before it is wound on the reel. Because of the great importance of keeping a perfectly smooth unmarred exterior surface extreme care is used in winding the cable on the reels and in handling the reels loaded with cable. Special precautions are taken to prevent the cable from being damaged by the reel during transfer or handling in the field. It may be of interest to note that the special steel reels for carrying the cable have been so designed as to eliminate all excess weight. One means of accomplishing this is through the use of removable spokes on which the reel revolves during the operation of winding and unwinding the cable. It may also be of interest to note that the cable is protected during transportation by a durable steel cover which completely encloses the cable.

(*Please turn to page 92*)

Production of Bolts, Nuts Screws and Rivets

(*Continued from page 83*)

Forging Nuts From Cold Bar Stock

AMONG the various machines developed by this concern is one for forming nuts cold from bar stock. The care with which these are made can be gauged from the fact that 7 different dies are employed. These are arranged in two groups with three on one side of the machine and four on the other. These nuts are given a black finish when necessary in a rotary gas fired furnace.

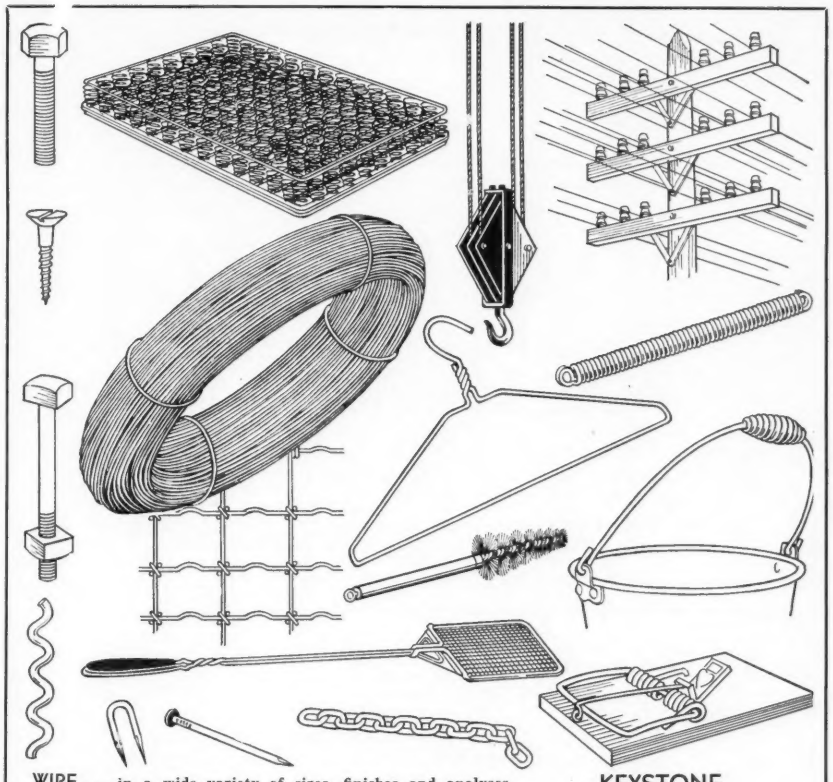
✦ ✦ ✦

Cleaning

ALL standard size bolts and nuts are cleaned in a perforated rotating steel cylinder 15 ft. long and 6 ft. in diameter. Half of this cylinder is enveloped in a sheet steel housing in which the hot water sprays and tank are located. Centrifugal pumps force this water from the tank through the sprays and the waste water runs back into the tank. The water is heated by a gas fired 100 gal. storage water heater equipped with an automatic temperature control by which the gas burner is turned off when too hot and turned on again when too cold.

General

THE handling of the work in this building alone requires 12 overhead traveling cranes and 5 monorail systems with hoists. Ordinarily more than 10,000 tons of raw and finished material is carried in stock. The central heat treating department has 5 gas fired furnaces. Recording and visual pyrometers are grouped on a central control board by which the temperatures of the various furnaces are carefully checked from time to time.



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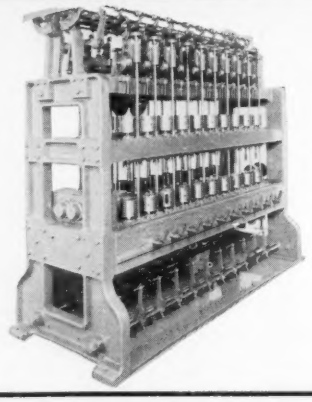

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ROUND AND SPECIAL SHAPES

THE BISSETT STEEL COMPANY

CLEVELAND

WORCESTER BUFFALO CINCINNATI

Hollow Core Bare Transmission Cable

(*Continued from page 90*)

This Type Cable New To United States

THE building of the Boulder Dam and the engineering of the electrical projects connected with the transformation of the tremendous water power into electrical energy supplied a great stimulus to the industrial and commercial activities of Southern California. Along with these increased activities have come engineering developments and advantages which heretofore we have lacked. Of these advantages one is the introduction to this country in a large way, of Hollow Core Bare Transmission Cable described in this article. The electrical industry abroad has had the advantages of these transmission cables for years and now this country is to enjoy them for the first time through the erection and equipping of General Cable Corporation's new factory in Los Angeles, California.

+ + +

Dry, Bright Annealing of Copper Wire

(*Continued from page 80*)

(d) The total overall annealing cost including the necessary protective atmosphere varies between ¼ and ½ of one per cent of the total cost of the wire annealed.

+ + +

Other Advantages

IN addition to obtaining the above essential results the bell type furnace has further distinct advantageous features. The short annealing cycle is very advantageous in meeting varying production requirements. The convenience of loading and unloading the furnace bases together with the automatic control of temperature and temperature gradient allow the equipment to be operated with a minimum of attention, yet obtaining duplication of results with a high degree of accuracy.

JOSIAH JUDD

Vice-Pres. Thomson-Judd Wire Machinery Co.

JOSIAH JUDD, Vice President and General Manager of The Thomson-Judd Wire Machinery Company, died at the New Haven Hospital, December 19, 1933, from a heart attack which resulted from a minor operation which he underwent in the early part of November. Mr. Judd was in his 63rd year.

✦ ✦ ✦

MR. Judd was born in England and at an early age his family moved to Canada and settled in Ontario. As a boy, he served his apprenticeship in a machine shop in Dundas, Ontario. After completing his apprenticeship he came to the United States, and settled in Worcester, Massachusetts, where he worked as a machinist. While in Worcester he completed the Worcester Mechanics' Association Course in drafting. From Worcester, Mr. Judd moved to New Haven, Connecticut, where he became associated with a machine tool manufacturer as a machine designer and sales engineer.

✦ ✦ ✦

ABOUT 18 years ago, Mr. Judd, with some associates, formed the New England Wire Machinery Company at New Haven, Connecticut, Mr. Judd being President of the Company. Special machinery, particularly stranding machines, were designed and built by this company. In connection with the sales work for this company, Mr. Judd was well known in practically every wire, wire rope and cable plant.

In 1928, when the New England Wire Machinery Company was reorganized under the name of the Wire Machinery Corporation of America, Mr. Judd became Vice President and General Sales Manager. In 1930 Mr. Judd sold his interest in this company, and a short time afterwards became associated with Mr. A. R. Petterson of Marblehead, Massachusetts. This association later developed into the formation of the Thomson-Judd Machinery Company of Lynn, Massachusetts.

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German Manufacturer Of Machinery offers for sale

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which are unsurpassed in their high production and economy of operation. They will be sold outright or granted on license.

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Thomson-Gibb Electric Welding Co.
Lynn, Massachusetts.

VIANNEY
Famous Wire Drawing Diamond Dies
250 EAST 43rd ST., N. Y. CITY

Exports and Imports

(*Continued from page 85*)

galvanized before weaving 2,574,750 square feet were received, this total being made up of 2,434,750 square feet had from Germany and 140,000 square feet from the Netherlands, while that galvanized after weaving—3,556,961 square feet—3,551,961 square feet came from Germany and 5,000 square feet from the Netherlands.

✦ ✦ ✦

EXPORTS of iron and steel wood screws during December totaled 39,280 gross, valued at $8,516. Of this total the United Kingdom took 11,056 gross; the Philippine Islands, 10,656 gross; Peru 3,400 gross and Cuba 2,478 gross.

✦ ✦ ✦

EXPORTS of brass wood screws totaled 2,445 gross; amounting to $931. Of this amount Panama took 741 gross; Canada 503 gross; Venezuela 307 gross and the Philippine Islands 230 gross.

✦ ✦ ✦

IMPORTS of wood screws during the same period amounted to 11,970 gross valued at $906. Of this amount Sweden supplied 8,300 gross and Germany 3,670 gross.

✦ ✦ ✦

INFORMATION is available through the office of the Bureau of Foreign and Domestic Commerce of the Department of Commerce, Washington, D. C., on an opportunity to sell "steel strips, hard, bright, cold rolled, for making bicycle chain links" at Osaka, Japan. In requesting these data please mention the number (7025) of this trade opportunity.

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H. J. Ruesch Machine Co., Newark, N. J.

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Balloffet Diamond Wire Dies Co., Inc., N. Y. C.
Cochaud Wire Die Co., New York.
Driver-Harris Co., Harrison, N. J.
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Vianney Wire Die Works, New York.

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John Robertson Co., Brooklyn, N. Y.

DIES—Repairs & Re-Cutting
Cochaud Wire Die Corp., New York.
Driver-Harris Co., Harrison, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Vianney Wire Die Wks., N. Y.

DIES—Rod and Tube Drawing
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Carboloy Co., Inc., Newark, N. J.
Firth-Sterling Steel Co., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tantalum Carbide
Bissett Steel Co., Cleveland, O.
Kelly Wire Die Corp., New York, N. Y.
Vianney Wire Die Works, New York, N. Y.

DIES—Tungsten Carbide
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Electric Furnace Co., Salem, O.

FURNACES—Automatic
Electric Furnace Co., Salem, O.

FURNACES—Bright Annealing
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FURNACES—Electric
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1934

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Vaughn Machinery Co., Cuyahoga Falls, O.

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Morgan Const. Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
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Broden Construction Co., Cleveland, O.
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Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Rubber Strip Covering
Farrel-Birmingham Co., Ansonia, Conn.
New England Butt Co., Providence, R. I.
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Rubber Tubing and Straining
John Royle & Sons, Paterson, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Screw Wire
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila. Pa.
Broden Construction Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry and Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spooling
American Insulating Machinery Co., Phila.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.

MACHINERY—Spring Making
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Broden Construction Co., Cleveland, O.
Lewis Machine Co., Cleveland, O.
H. J. Ruesch Machine Co., Newark, N. J.
F. B. Shuster, New Haven, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Stranding
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Broden Const. Co., Cleveland, O.
Lewis F'dry & Machine Co., Pittsburgh, Pa.
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Swaging
H. J. Ruesch Machine Co., Newark, N. J.
Sleeper & Hartley, Worcester, Mass.

MACHINERY—Taping
Amer. Insulating Mach. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Tinsel Rolling Mills
Amer. Insulating Mach'y Co., Phila., Pa.

MACHINERY—Trolley Wire
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
H. J. Ruesch Machine Co., Newark, N. J.

MACHINERY—Welding Wire
Lewis Machine Co., Cleveland, O.
Micro Products Co., Chicago, Ill.
F. B. Shuster Co., New Haven, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Drawing
American Insulating Machinery Co., Phila.
Broden Const. Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
H. J. Ruesch Machine Co., Newark, N. J.
E. J. Scudder Foundry & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Thomson-Judd Wire Machinery Co., Lynn, Mass.
Watson Machine Company, Paterson, N. J.

PICKLING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Grasselli Chemical Co., Cleveland, O.
Wm. M. Parkin & Co., Pittsburgh, Pa.

MACHINERY—Wire Tinning
American Insulating Mach'y Co., Phila., Pa.

PAPER—Insulating
National Patent Reed Co., Philadelphia, Pa.

POTS—Lead Melting
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Encasing
John Robertson Co., Brooklyn, N. Y.

PRESSES—Lead Extrusion
John Robertson Co., Brooklyn, N. Y.

PULLERS—Wire
E. J. Scudder Fdry. & Machine Co., Trenton, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.

PUMPS—Hydraulic
John Robertson Co., Brooklyn, N. Y.

REELS AND SPOOLS—All Kinds
Avoca Mfg. Co., Avoca, N. Y.
R. B. Hayward Co., Chicago, Ill.
Lewis Machine Co., Cleveland, O.

REEL AND TENSION STAND—
Sleeper & Hartley, Inc., Worcester, Mass.

REEL CRUTCHES
R. B. Hayward Co., Chicago, Ill.
Watson Machine Co., Paterson, N. J.

ROLLING MILLS—See Machinery—Rolling Mill

ROLLS—
Lewis F'dry & Machine Co., Pittsburgh, Pa.
United Eng. & Fdry. Co., Pittsburgh, Pa.

RUST PROOF COMPOUND
American Lanolin Co., Lawrence, Mass.

SOAPS—Wire Drawing
Drakenfeld & Co., B. F., New York, N. Y.
R. H. Miller Co., Homer, N. Y.
Robertson Co., J. T., Inc., Syracuse, N. Y.

STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

TANKS—Compound
Watson Machine Co., Paterson, N. J.

TRUCKS
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

TUBE BENDERS AND FORMERS
H. J. Ruesch Machine Co., Newark, N. J.

VULCANIZERS
John Royle & Sons, Paterson, N. J.
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS
American Insulating Mach'y Co., Phila., Pa.

WIRE—Enameled For Coils
Winsted Insulated Wire Co., Winsted, Conn.

WIRE—Manufacturers
Keystone Steel & Wire Co., Peoria, Ill.

WIRE—Nickel Silver and Phosphor Bronze
Seymour Mfg. Co., Seymour, Conn.

WIRE—Non Ferrous to Specification
Seymour Mfg. Co., Seymour, Conn.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Keystone Steel & Wire Co., Peoria, Ill.

WIRE AND STRIP—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

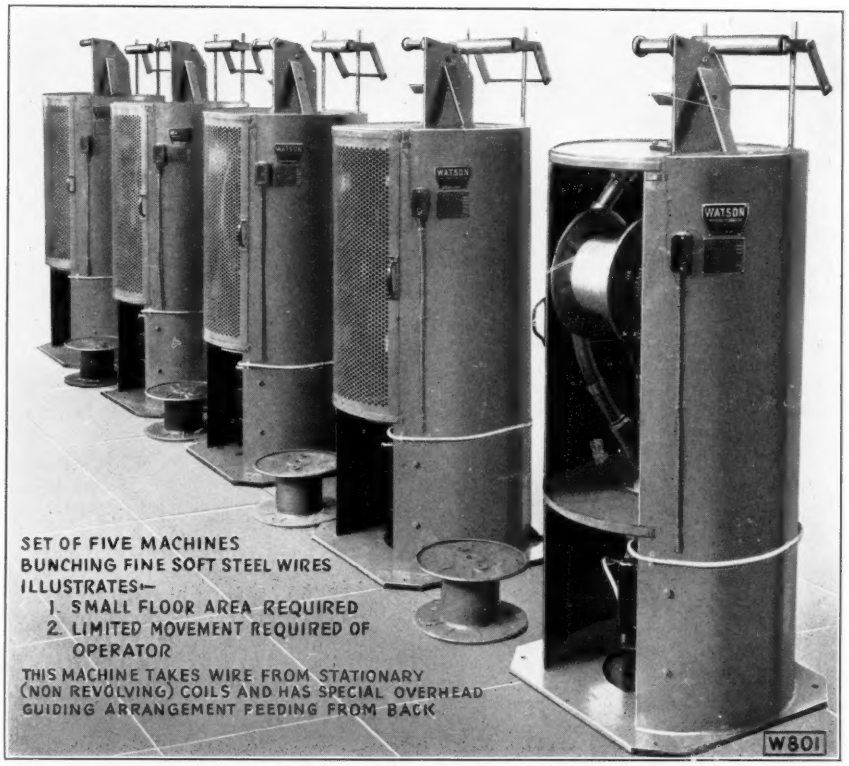
This is a carefully classified index of concerns who specialize in this industry and who advertise regularly in WIRE & WIRE PRODUCTS. Please mention WIRE when writing to these firms.

The Watson Machine Company

ESTABLISHED 1845

Paterson, New Jersey, U. S. A.

Engineers . Founders - Machinists

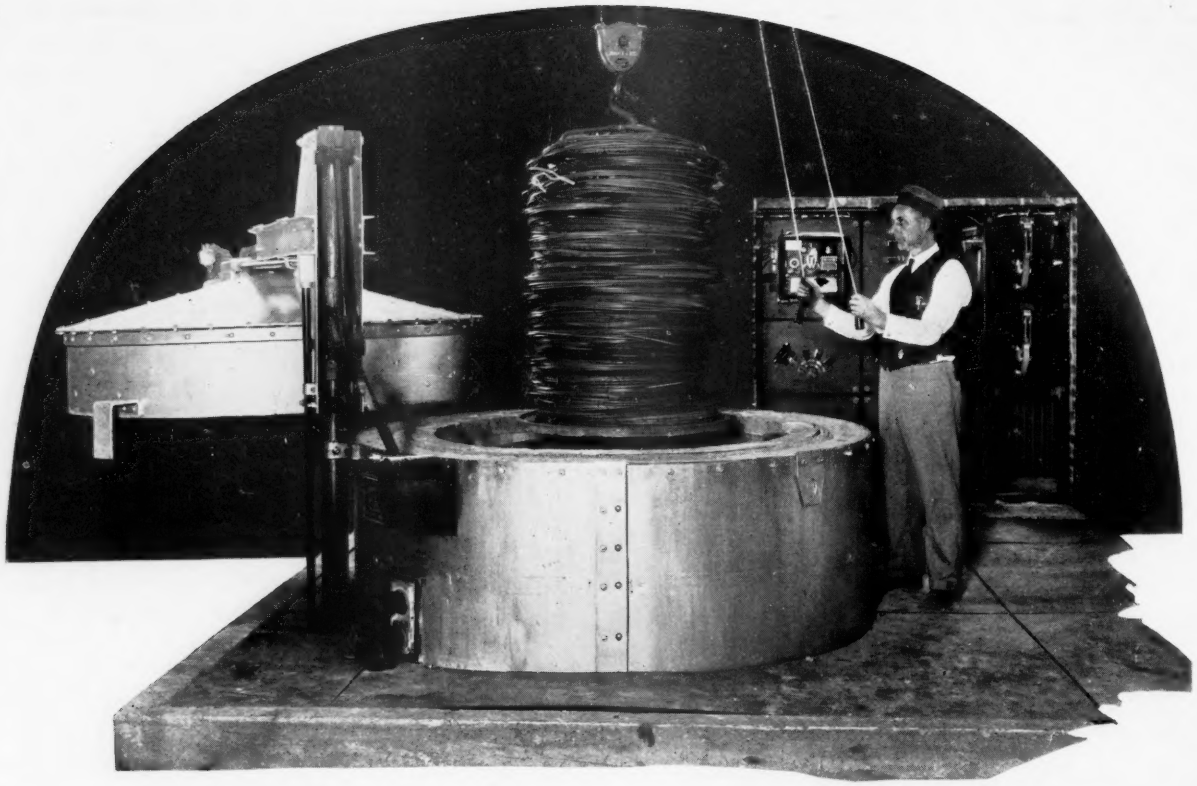

WATSON
WATSON
SET OF FIVE MACHINES
BUNCHING FINE SOFT STEEL WIRES
ILLUSTRATES—
1. SMALL FLOOR AREA REQUIRED
2. LIMITED MOVEMENT REQUIRED OF OPERATOR
THIS MACHINE TAKES WIRE FROM STATIONARY (NON REVOLVING) COILS AND HAS SPECIAL OVERHEAD GUIDING ARRANGEMENT FEEDING FROM BACK
W801

A modern high capacity installation of five WATSON BUNCHERS V7 for fine wire bunching, for single operator is shown above.

At 1″ lay 42,000 feet of strand is produced hourly.

Small floor area, and automatic electric stops enable single operator to take care of eight machines with ease.

Send for latest bulletin and prices.



Furnaces for the Wire Industry

The above illustration shows one unit of an installation of furnaces made in a prominent steel plant for annealing alloy wire rod in coils, without scale or decarburization,—a special furnace for a special process. Recent developments and installations include several other interesting furnaces for the wire industry, including:

Improved Pit Type Furnaces

For Annealing Steel Wire in Coils, which offers the following advantages:

Increased tonnage per pit.
Improved fuel economy.
More uniformly annealed wire.
Improved surface conditions.
Decreased annealing time and labor requirements.
Maximum flexibility,—wire can be annealed bright or dull.

Continuous Furnaces

For Bright Annealing Copper Wire.

A new continuous furnace for bright annealing fine copper wire on spools. The spools are loaded into trays and pushed through the furnace by hydraulically operated pusher head, pushing at any predetermined intervals. The material is discharged from the furnace uniformly annealed, bright, clean and dry.

Other recent installations include continuous furnaces for billet heating, bright annealing, brazing, carburizing, hardening and other heating and heat treating processes;—put your problems up to our engineers.

WE BUILD THE FURNACE TO FIT THE JOB

THE ELECTRIC FURNACE CO.
SALEM, OHIO.

FUEL FIRED FURNACES

ELECTRIC FURNACES